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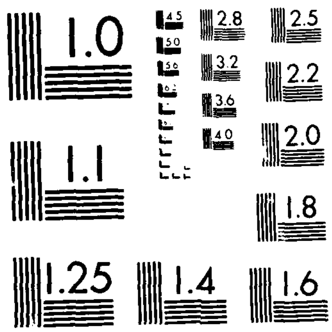
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FEASIBILITY STUDY OF CONTAMINATION REMEDIATION AT NAVAL WEAPONS STATION, CONCORD, CALIFORNIA

Volume I: Remedial Action Alternatives

by

M. John Cullinane, Jr., Charles R. Lee, L. Jean O'Neil

Environmental Laboratory

DEPARTMENT OF THE ARMY
Waterways Experiment Station, Corps of Engineers
PO Box 631, Vicksburg, Mississippi 39180-0631

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September 1988

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This report identifies and describes potential remedial actions to eliminate or mitigate the release of hazardous substances onto lands of the Naval Weapons Station, Concord, CA. Hazardous substances identified as necessitating remedial actions include lead, cadmium, zinc, copper, selenium, and arsenic. The proposed remedial actions are designed to address existing or potential impacts identified in a separate study. These identified impacts include: contamination of soil with metals; contamination and toxicity in plants and soil invertebrates; reduced plant growth; increased soil acidity; surface water contamination; air contamination; loss of quantity and quality of wildlife habitat; loss of wetland function; and loss of ultimate land use.

The release of hazardous substances at seven sites was identified in the remedial investigation. The seven individual areas were consolidated into four remedial action subsites (RASS's) based on an analysis of the topography and nature of the habitat.

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Based on the results of the remedial investigation, the extent of contamination and potential migration pathways were evaluated. Applicable or Relevant and Appropriate Requirements were identified and used as the basis for selection of general and specific environmental protection goals and objectives. Chemical specific criteria and locational specific factors were evaluated to develop specific clean up criteria for each RASS.

Twenty four remedial action technologies were initially assessed, with nine technologies applicable to the conditions found at NWS Concord. Alternative remedial actions were developed for each RASS. Alternatives for each RASS were initially screened based on environmental and public health considerations, engineering feasibility, and cost. Promising alternatives were selected for detailed evaluation. Detailed evaluation factors included: technical feasibility, environmental considerations, institutional considerations, public health considerations, and cost. Alternative remedial actions for each RASS were ranked in order of preference.

PREFACE

This report presents the results of a comprehensive remedial action feasibility study at the Naval Weapons Station, Concord, CA.

This study was conducted at the US Army Engineer Waterways Experiment Station (WES) by Mr. M. John Cullinane, Jr., Research Civil Engineer, Water Supply and Waste Treatment Group; Dr. C. R. Lee, Soil Scientist, Contaminant Mobility and Regulatory Criteria Group; and Ms. L. Jean O'Neil, Wildlife Biologist and Ecologist, under the general supervision of Dr. R. L. Montgomery, Chief, Environmental Engineering Division; Mr. D. L. Robey, Chief, Ecosystem Research and Simulation Division; Dr. C. J. Kirby, Chief, Environmental Resources Division; and Dr. John Harrison, Chief, Environmental Laboratory.

Technical contributions in report preparation were received from the following WES scientists: Mr. J. G. Skogerboe, Hydrologist, and Mr. Richard Price, Agronomist, for map presentation; Mr. Hollis Allen, for review of the wetland restoration plan; Mr. Dennis Brandon, Statistician, for data analysis; and Mr. Roy Wade, Civil Engineer, for assistance in cost estimating. Dr. K. D. Jenkins, Director, Molecular Ecology Institute, California State University, Long Beach, CA, prepared the review of surface water and soil chemical data and provided constructive comments on the report as a whole.

Constructive comments on the study and draft reports were received from Dr. W. H. Patrick, Jr., Director, Center for the Wetland Resources, Louisiana State University Baton Rouge, LA; Dr. R. J. Kendall, Environmental Toxicological Services, Bellingham, WA; Dr. R. K. Ringer, Professor of Physiology and Animal Science, Michigan State University, East Lansing, MI; Dr. M. N. Josselyn, Director Tiburon Center for Environmental Studies, San Francisco State University, Tiburon, CA; Dr. H. T. Harvey, Ecologist and President, Harvey and Stanley Associates Inc., Alviso, CA; Dr. E. Meyer, Chemist, Meyer Consultants Inc., Lockport, IL; Dr. R. N. Coats, Wildlife Resource Scientist, Philip Williams and Associates, San Francisco, CA.

Additional review and comments were received from Mr. J. M. Robertson, Esq., Office of the General Counsel, Department of the Navy, Washington, D.C.; Mr. C. Schwab, Environmental Engineer, Western Division Naval Facilities

Engineering Command, San Bruno, CA; and Mr. Rich Pieper, Public Works Office, Naval Weapons Station, Concord, CA.

Director of WES during the preparation of this report was COL Dwayne G. Lee, CE. Technical Director was Dr. Robert W. Whalin.

This report should be cited as follows:

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EXECUTIVE SUMMARY

Background

The Naval Weapons Station, Concord (NWS Concord) is located in the north-central portion of Contra Costa County in the San Francisco Bay Area of California. The general location of NWS Concord is shown on Plate E.1. The station is the major ammunition transshipment port on the west coast for the Department of the Navy. It is approximately 30 miles northeast of the City of San Francisco. NWS Concord is bounded on the north by Suisun Bay and on the the south and west by the City of Concord, which has a population slightly in excess of 100,000 residents (Ecology and Environment 1983). NWS Concord encompasses over 12,904 acres of land consisting of three land holdings: the Tidal Area, the Inland Area (linked to the Tidal Area by a narrow Navy-owned rail and road corridor) near the City of Concord, and a radiography facility located at Pittsburg, California.

An Initial Assessment Study (IAS) (Ecology and Environment 1983) conducted in accordance with the Navy Assessment and Control of Installation Pollutants (NACIP) program evaluated 32 sites. Of these, 25 sites were identified as being of potential interest, and 13 were determined to warrant further study under the NACIP program. In accordance with NACIP program requirements, a Confirmation Study was initiated on 9 of the 13 sites sites recommended for further study in the IAS (Ecology and Environment 1983). These sites were identified as: AA (IAS Site 4), AB (IAS Site 5), G-1 (IAS Site 26), K-2 (IAS Site 25), KS (IAS Site 3), CP (IAS Site 6), Burn Area (IAS Site 13), Black Pit at Red Rock (IAS Site 16), and Kinne Boulevard Wells (IAS Site 14). The Confirmation study confirmed the presence of high arsenic and/or heavy metals in soils in the AA, AB, KS, G-1, K-2, and CP areas.

The findings presented in the Draft Confirmation Study Report triggered the conduct of a Remedial Investigation in areas designated as AA, AB, KS, G-1, K-2, and CP. During the conduct of the RI, an additional site, ES, was identified as having been contaminated. The results of the RI and additional investigations have been documented in several reports (Lee et al. 1985, Lee

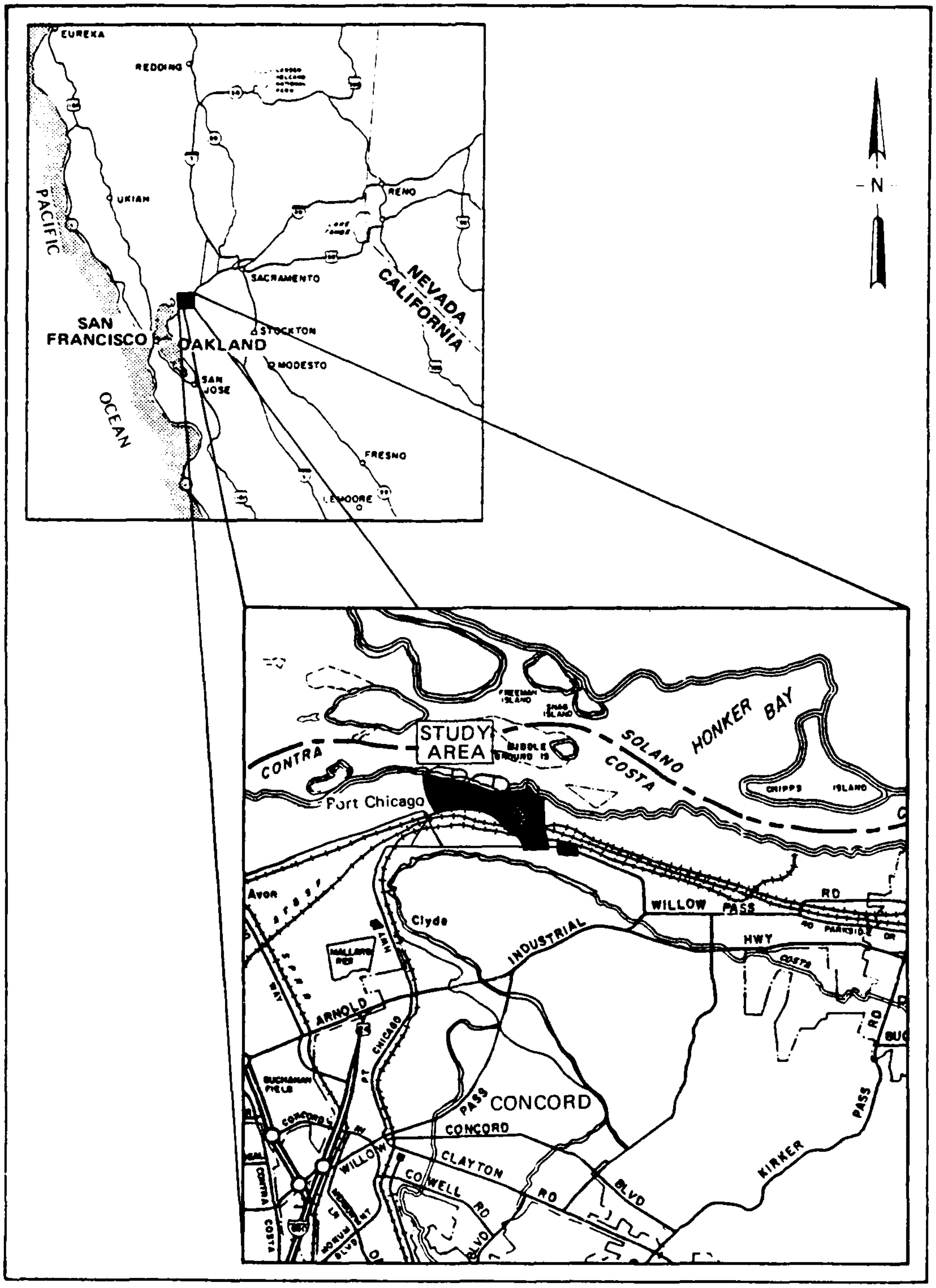

Plate E.1. Location of NWS Concord study area.

et al. 1986, and Lee et al. 1988). The RI identified areas of contamination and recommended that implementation of remedial actions be considered for one or more of the contaminated areas. As a result of the conclusions contained in the Final Draft Report on the Remedial Investigation of Contaminant Mobility, in August 1985, the Navy issued a Final Draft Report of the Feasibility Study of Contamination Remediation for the AA, AB, G-1, K-2, KS, and Coke Pile (CP) areas on Parcels 572, 573, 574, 575, and 581 on NWS Concord. In February, 1986, the Navy issued a Final Report of the Remedial Investigation of Contaminant Mobility (Lee et al. 1986). In March, 1986, the Navy issued a Revised Final Draft Feasibility Study of Contamination Remediation for the AA, AB, G-1, K-2, ES, and CP areas on Parcels 572, 573, 574, 575, 576, 579D, and 581 on NWS Concord (Cullinane et al. 1986). Subsequent to issuing the Revised Final Draft Feasibility Study Report, the Navy conducted additional investigations of contamination in Parcels 572, 573, 574, 575, 576, 579D, and 581 (Lee et al. 1988).

To address concerns that the State of California Regional Water Quality Control Board (RWQCB) raised about the Navy's response on the seven areas on Parcels 572, 573, 574, 575, 576, 579D, and 581 on NWS Concord in April and May 1987, the Navy developed conceptual plans for additional investigations of potential surface and ground water contamination on these parcels (US Navy 1987). On October 2, 1987, the Navy solicited comments concerning these conceptual plans from the Regional Board. The Navy submittal to the RWQCB contained an extensive assessment of the contamination present in soils, biota, and surface water. The Navy is continuing planning and execution of additional investigations requested by the Regional Board.

Because of the additional data gathered subsequent to issuance of the Revised Draft Feasibility Study Report, comments received by the Navy in response to the Revised Draft Feasibility Study, and enactment of the Superfund Amendments and Reauthorization Act of 1986, the Navy has prepared this Revised Final Draft Feasibility Study Report.

The scope of this Feasibility Study is limited to the areas formerly noted as AA, AB, KS, G-1, ES, K-2, and CP on Parcels 572, 573, 574, 575, 576, 579D, and

581 on NWS Concord. Other areas identified in the IAS are the subject of other separate remedial investigations.

Nature and Extent of Contamination

The Final RI (Lee et al. 1986) identified soil contamination resulting from discharges from adjacent properties and operations on the areas prior to acquisition by the Navy. The primary potential of onsite contamination are surficial deposits of metal contaminants resulting from drainage or overflows of wastewaters to surface drainages or to flat wetland areas from adjacent properties. The surficial deposits have been evaluated and found to contain high levels of arsenic, lead, cadmium, copper, and zinc. To date, organic chemical contamination has not been identified as a problem in these areas. In addition, offsite contamination on adjacent properties in the form of deposits of metal contaminants has been identified as potential offsite sources of contamination.

Based on the types of identified contamination, natural topographic and habitat differences, and the potential for applying a variety of remedial measures, the seven areas of contamination previously identified as AA, AB, KS, G-1, K-2, ES, and CP were aggregated into four separate remedial action subsites, described as RASS 1, RASS 2, RASS 3, and RASS 4. These sites contain approximately 308 acres and including both wetland and upland potions of the tidal plain adjacent to Suisun Bay. The location and general boundaries of each RASS are presented in Plate E.2. Table E.1 describes the four RASS's and subareas within each RASS. A complete description of the nature and extent of contamination on each subsite is presented in Ecology and Environment (1983), Anderson Geotechnical (1984), Lee et al. (1985), Lee et al. (1986), Lee et al. (1988), and US Navy (1987).

Two reference areas were established (Plate E.2) to allow sampling in locations believed to contain background levels of contamination. One was established in wetlands and the other in upland conditions.

RASS 1. RASS 1 includes areas formerly identified as AA and AB on Parcel 572 on NWS Concord. RASS 1 contains approximately 210 acres of land. Elevated

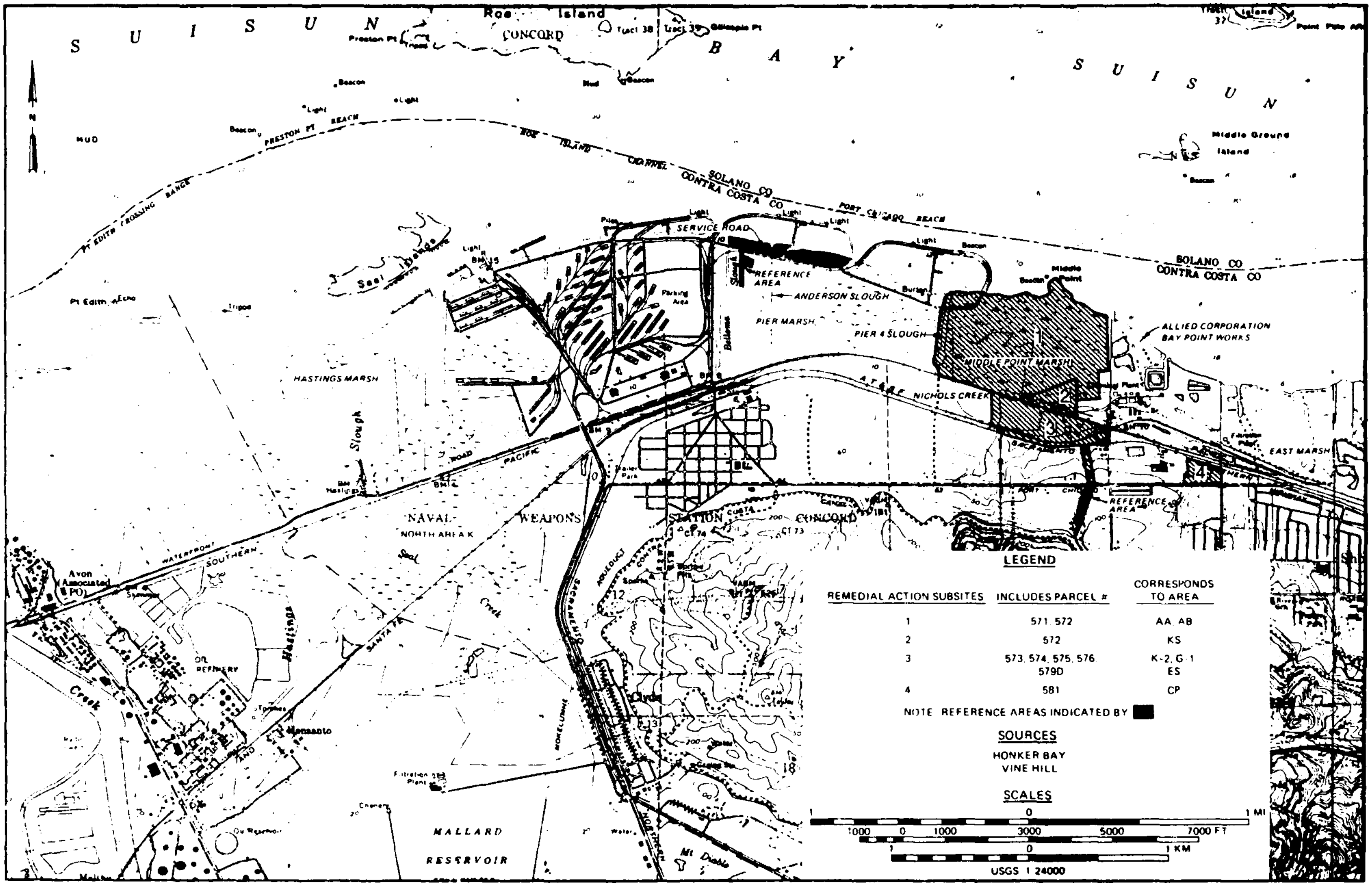

Plate E.2. Location of Remedial Action Subsites (RASS) and Reference Areas

Table E.1

Summary of Areas in Each RASS

Area	Description	Wetland Area	Non-Wetland Area	Total Acres in Subareas
Rass 1				
572-N	Parcel 572 owned by the Navy	111.38	1.48	112.86
571-N	Parcel 571 owned by the Navy	11.31	--	11.31
571-SF	Property adjacent to Parcel 571 owned by ATSF	0.85	--	0.85
571-SP	Property adjacent to Parcen 571 owned by SPTC	0.05	0.36	0.41
CC*	Property controlled by Contra Costa County	7.41	--	7.41
CC-SF*	Property adjacent to the Contra Costa County Property owned by ATSF	0.36	--	0.36
CC-SP*	Property adjacent to the Contra Costa County Property owned by SPTC	0.19	--	0.19
Other-N*	Property to the west of Parcel 571 owned by the Navy	68.38	--	68.38
Other-SF*	Property to the west of Parcel 571 owned by ATSF	4.00	--	4.00
Other-SP*	Property to the west of Parcel 571 owned by SPTC	1.15	1.14	2.29
Stream*	Area of stream bed between Parcel 571 and 572	1.72	--	1.72
SUBTOTAL		206.80	2.98	209.78
Rass 2				
572-N	Parcel 572 owned by the Navy	3.97	4.25	8.22
572-SF	Property adjacent to Parcel 572 owned by ATSF	1.28	2.01	3.29
572-SP	Property adjacent to Parcel 572 owned by SPTC	0.19	1.62	1.81
SUBTOTAL		5.44	7.88	13.32
Rass 3				
573-Other-SP*	Property to the west of Parcel 573 owned by SPTC	0.43	--	0.43
573-Other-N*	Property to the west of Parcel 573 owned by the Navy	3.23	2.44	5.67
573-Other-SF*	Property to the west and south of Parcel 573 owned by ATSF	0.02	0.98	1.00
573-SP	Property adjacent to Parcel 573 owned by SPTC	--	0.82	0.82
573-N	Parcel 573 owned by the Navy	6.25	5.30	11.55
573-SF	Property adjacent to Parcel 573 owned by ATSF	--	1.60	1.60
574-SP	Property adjacent to Parcel 574 owned by SPTC	--	0.72	0.72
574-N	Parcel 574 owned by the Navy	1.75	9.28	11.03
574-SF	Property adjacent to Parcel 574 owned by ATSF	--	0.81	0.81
575-SP	Property adjacent to Parcel 575 owned by SPTC	--	1.26	1.26
575-N	Parcel 575 owned by the Navy	0.25	8.53	8.78
575-SF	Property adjacent to Parcel 575 owned by ATSF	--	1.37	1.37
576-SF	Property adjacent to parcel 576 owned by ATSF	--	1.73	1.73
576-N	Parcel 576 owned by the Navy	0.01	1.86	1.87
576-SN	Property adjacent to Parcel 576 owned by SNR	--	1.21	1.21
5769D-Other-N	Property adjacent to Parcel 579D owned by the Navy	--	15.21	15.21
579D-N	Parcel 579D owned by the Navy	0.23	5.46	5.69
579D-SN	Property adjacent to Parcel 579D owned by SNR	--	0.26	0.26
579D-CP-SN	Property adjacent to Parcel 579D and Chemical and Pigment property owned by SNR	--	0.20	0.20
SUBTOTAL		12.17	59.04	71.21
Rass 4				
581-N	Parcel owned by the Navy	0.68	10.01	10.69
581-Other-N*	Property adjacent to Parcel 581 owned by the Navy	2.50	0.10	2.60
SUBTOTAL		3.18	10.11	13.29
TOTAL		227.59	80.1	307.60

RASS 2. RASS 2 includes the Kiln Site (KS) and encompasses approximately 13 acres on Parcel 572. RASS 2 includes approximately 5 acres adjacent to concentrations (statistically above background concentrations) of arsenic, cadmium, copper, and zinc have been detected in the soil at this site. Soil pH values as low as 4.6 have also been observed. Contamination is generally limited to the upper 12 inches of soil.

Parcel 572, on right-of-way owned and operated by Atchison, Topeka and Santa Fe Railway Company (ATSF). Elevated concentrations (statistically above background concentrations) of arsenic, cadmium, zinc, copper, and lead have been detected in the soil from this area. The majority of the contamination is believed to be in the upper 12 inches of soil, however, some data indicate contamination to depths greater than 36 inches in small isolated areas. Partial removal of soil and debris was undertaken in 1982.

RASS 3. RASS 3 includes areas formerly identified as K-2, G-1, and ES on Parcels 573, 574, 575, 576, and 579D and encompasses approximately 71 acres. Elevated concentrations (statistically above background concentrations) of cadmium, copper, lead, and zinc have been detected in the soil from this area. A small stream flows through this site before discharging into the tidal marsh.

RASS 4. RASS 4 includes the area formerly designated as the Coke Pile or CP area on Parcel 581. RASS 4 contains approximately 13 acres of land. Elevated concentrations (statistically above background concentrations) of arsenic, cadmium, lead, copper, zinc and selenium have been found in the soil from this area. In addition, pH values below 5.0 have been observed in the soil at a number of locations on RASS 4.

Sources on Adjacent Properties

Six adjacent properties contain sources of potential contamination to NWS Concord. Allied Corporation owns and operates the Bay Point Works located immediately east of Parcel 572 on NWS Concord. Eight potential sources of contamination are located on this property. These sources include the old alum pond, lined alum storage ponds, iron pyrite cinder and coke disposal

area, wastewater treatment pond, iron pyrite ore storage area, gypsum disposal area, lead arsenate disposal area, and lead arsenate burial area. The Chemical & Pigment Company property located adjacent and east of Parcel 579D on the NWS Concord contains two potential sources including a wastewater treatment/recirculation lagoon and a waste burial area. Three railroads (Atchison, Topeka, and Santa Fe Railway Company; Southern Pacific Transportation Company; and Sacramento Northern Railroad) transit Parcels 572, 573, 574, 575, 576, 579D, and 581 on NWS Concord. Surficial contamination similar to that found on NWS Concord proper has been identified on these rights-of-way.

Soil Contamination

Since 1983, extensive data have been collected that delineate the horizontal distribution of potentially hazardous substances in the soils of RASS 1, RASS 2, RASS 3, and RASS 4. Both soil and biota analyses were used to evaluate the extent of soil contamination. RASS 1 has extensive arsenic contamination and localized lead and copper contamination. RASS 2 has extensive cadmium, lead, and zinc contamination and more limited arsenic and copper contamination. RASS 3 has extensive cadmium, lead, and zinc contamination and more limited arsenic and copper contamination. RASS 4 has significant cadmium and lead contamination and more limited arsenic and selenium contamination.

Several studies examined the vertical distribution of contamination. No contamination was found below a depth of 12 inches in RASS 1. In RASS 2, RASS 3, and RASS 4, the contamination is generally well defined by the existing data and limited to the top 12 inches. In a few localized areas of RASS 2 and RASS 3, however, zinc, lead, copper, and cadmium contamination extends below 12 inches and in some instances exceeded the TTLC and STLC criteria at the greatest depth sampled (36 inches).

In 1984, soil samples from RASS 1, RASS 2, RASS 3, and RASS 4 were collected from six locations for analysis for extractable organic priority pollutants. At five locations, all of the extractable organic pollutants were below detection limits. At one location, located in the vicinity of RASS 3, five priority pollutants were detected at low concentrations ranging from 200-500 ppb. As part of the same study, samples collected on RASS 1 were analyzed for

purgable priority pollutants. The concentration of purgable priority pollutants was below detectable limits at both locations sampled.

Surface Water

Two studies provide information on the concentration and distribution of arsenic and metals in surface waters on and near RASS 1, RASS 2, RASS 3, and RASS 4 (Pacific Environmental Laboratories (PEL) 1983, Brown and Caldwell 1985). Because of the interconnection and interaction among RASS 1, 2, and 3, surface water quality in these areas is reviewed together. Surface water data show that arsenic, cadmium, copper, lead, nickel, and zinc exceeded national chronic and/or acute water quality criteria at several sampling stations.

Surface water samples collected from the wetlands to the northwest of RASS 4 and standing water after a rainfall had concentrations of copper, lead, and selenium exceeding national chronic and/or acute water quality criteria at several sampling stations.

Surface water samples from three locations were analyzed for organic priority pollutants (PEL 1983). With the exception of two phthalate compounds, none of the organic priority pollutants were detected in these samples. The phthalate compounds were present at low concentrations of 2-4 ppb in the samples from the wetlands of RASS 3 and the creek west of RASS 1 and RASS 2. It is important to note that these phthalate compounds are common laboratory contaminants.

The surface water sampling program was augmented by clam bioaccumulation studies. In these studies, clams were placed in plastic cages suspended in the surface water for a 30-day period. Following the 30-day exposure period, mortality was recorded and the tissues of the surviving organisms were analyzed for arsenic, cadmium, copper, nickel, lead, selenium, and zinc. Two clam bioaccumulation studies were conducted (1984 and 1986). Elevated levels of metals were found at several of the sampling stations within RASS 1, RASS 2, and RASS 3.

Taken together, the surface water and clam bioaccumulation data indicate that several of the metals found in the contaminated surface soils are also elevated in the surface waters and are potentially bioavailable to aquatic organisms and may currently impair water quality in these areas. However, clam bioaccumulation data do not indicate that the water quality of Suisun Bay has been adversely impacted, even after flood conditions in the winter of 1986.

Ground Water

The geology and types of contamination found on Parcels 572, 573, 574, 575, 576, 579D, and 581 on NWS Concord combine to limit the potential for migration of contaminants into the underlying ground water. To date, extensive investigations of the ground water have not been conducted. However, data from a number of studies (Brown and Caldwell 1985, Kleinfelder and Associates 1983, Allied Corporation 1977, Harding-Lawson 1977) indicate that groundwater contamination is unlikely.

The Navy installed three ground water monitoring wells on the north side of RASS 2 and a reference well approximately 1600 ft. south of RASS 2. Samples collected from the wells were analyzed for total and dissolved zinc, copper, cadmium, arsenic, lead, and selenium. Cadmium and lead concentrations exceeded background concentration; however, analysis of the data was complicated by relatively high background levels in this non-potable aquifer.

Bioaccumulation in Terrestrial Plants and Animals

Extensive studies of bioaccumulation in terrestrial plants and animals have been conducted (Lee et al. 1986, Lee et al. 1988, and O'Neil 1988). Significant bioaccumulation of arsenic, cadmium, lead, and selenium was demonstrated.

Air Contamination

No quantitative studies of air contamination have been conducted. Visual observations of contaminated areas indicate the possibility of fugitive dust generation and offsite transport of contamination from the barren areas found on RASS 1, RASS 2, and RASS 4.

Summary

A summary of the concentrations of heavy metals found in the various environmental media on each RASS is presented in Table E.2.

Environmental Goals

An evaluation of the contaminant types and concentrations found in the contaminated areas included in this feasibility study indicates that the primary contaminants of concern are arsenic, cadmium, copper, lead, selenium, and zinc. Based on a variety of existing standards, the contamination has degraded surface soils and is a present and/or potential danger to human health and the environment, including wildlife and vegetative populations using the RASS 5 or areas adjacent to the contamination.

The principal impact to the environment at NWS Concord is the contamination of wildlife habitats and the continued migration of hazardous substances into the environment surrounding those areas currently contaminated. Surface soil contamination is the primary concern because of the following potential endangerment to receptors.

a. Existing and future human users of the contaminated areas through direct contact.

b. Existing and future wildlife users coming into direct contact with contaminated areas.

c. Vegetation coming into direct contact with contaminated areas.

d. Wildlife exposed to hazardous substances via food chain contamination.

e. Human, wildlife, and vegetation exposed to contamination resulting from the continued migration of contaminants into the environment.

Table E.2

Summary of Contamination on RASS's 1, 2, 3, and 4 and Reference Area

	SOIL			PLANTS			EARTHWORMS			CLAMS		
Variable	N	Minimum Value	Maximum Value	N	Minimum Value	Maximum Value	N	Minimum Value	Maximum Value	N	Minimum Value	Maximum Value
RASS 1												
AS	109	3.0	2484.8	54	0.0	26.7	63	2.2	150.6	28	1.1	2.4
CD	109	0.0	75.4	54	0.0	2.1	63	0.2	13.7	28	0.0	2.7
CU	109	25.3	1268.1	54	1.5	16.5	63	6.1	159.2	28	43.5	87.9
PB	109	0.0	428.8	54	0.0	4.5	63	0.0	19.9	28	0.0	1.0
ZN	109	50.1	3998.1	54	7.4	159.7	63	102.0	400.9	28	100.8	167.5
NI	109	10.7	104.3	54	0.0	7.9	63	0.0	14.3	28	0.0	4.5
SE	67	0.0	11.8	54	0.0	1.0	63	1.4	8.4	28	0.8	1.5
pH	109	3.8	7.4									
RASS 2												
AS	8	5.1	103.1	5	0.0	0.0	5	4.3	25.6	--	--	--
CD	8	8.9	88.5	5	4.8	41.7	5	9.0	53.7	--	--	--
CU	8	96.4	1498.5	5	0.0	13.2	5	22.9	187.7	--	--	--
PB	8	48.7	4675.2	5	0.4	24.3	5	2.3	23.6	--	--	--
ZN	8	740.7	50276.9	5	137.1	555.9	5	152.7	433.2	--	--	--
NI	8	38.8	75.0	5	1.4	10.6	5	2.9	5.8	--	--	--
SE	5	0.1	4.3	5	0.0	0.0	5	1.2	15.4	--	--	--
pH	8	5.2	8.2									
RASS 3												
AS	83	0.8	303.0	53	0.0	0.4	54	1.4	19.9	30	0.9	2.4
CD	83	0.2	45.2	53	0.0	26.6	54	2.2	21.9	30	0.2	1.5
CU	83	7.0	3053.3	53	1.7	20.1	54	7.4	103.5	30	44.1	83.1
PB	83	0.4	7599.7	53	0.0	10.5	54	0.0	224.6	30	0.0	9.2
ZN	83	34.5	85494.2	53	20.1	788.6	54	110.4	631.9	30	113.3	284.0
NI	83	6.4	257.6	53	0.0	9.8	54	0.8	7.1	30	0.0	10.1
SE	54	0.0	1.3	53	0.0	0.0	54	2.2	20.2	30	0.7	2.1
pH	83	4.3	8.3									

(Continued)

N = Number of Samples.
All values except N and pH are in mg/kg or parts per million (dry weight basis).
AS-Arsenic, CD-Cadmium, CU-Copper, PB-Lead, ZN-Zinc, NI-Nickle, SE-Selenium.

Table E.2 (Concluded)

Variable	SOIL N	SOIL Minimum Value	SOIL Maximum Value	PLANTS N	PLANTS Minimum Value	PLANTS Maximum Value	EARTHWORMS N	EARTHWORMS Minimum Value	EARTHWORMS Maximum Value	CLAMS N	CLAMS Minimum Value	CLAMS Maximum Value
RASS 4												
AS	37	2.0	89.8	11	0.0	1.6	14	1.7	14.7	--	--	--
CD	37	0.1	29.1	11	4.0	24.9	14	0.8	29.4	--	--	--
CU	37	8.6	253.8	11	5.8	13.1	14	1.4	91.3	--	--	--
PB	37	0.5	4054.7	11	0.0	65.4	14	0.0	76.7	--	--	--
ZN	37	25.0	427.2	11	29.4	118.8	14	111.8	336.3	--	--	--
NI	37	2.9	97.5	11	0.8	17.7	14	1.1	12.0	--	--	--
SE	37	0.0	138.4	11	0.0	11.7	14	3.3	91.3	--	--	--
pH	37	2.9	7.0									
Reference Area												
AS	32	0.1	6.7	29	0.0	0.7	30	0.9	9.9	18	1.5	2.6
CD	32	0.0	3.5	29	0.0	2.0	30	1.6	11.8	18	0.6	0.9
CU	32	5.5	72.8	29	1.0	9.0	30	7.1	14.7	18	39.9	86.0
PB	32	0.0	74.7	29	0.0	1.1	29	0.0	5.8	18	0.0	1.2
ZN	32	25.0	471.6	29	19.4	206.6	30	99.5	162.4	18	99.9	140.0
NI	32	9.7	86.8	29	0.0	4.3	30	0.2	10.3	18	0.0	2.1
SE	30	0.0	27.3	29	0.0	0.0	30	2.1	15.8	18	0.9	2.3
pH	32	4.7	8.2									

f. Exposure of humans in the immediate vicinity of the contaminated areas.

g. Release of hazardous substances via a catastrophic flood or earthquake.

The general environmental protection goal for remediation that the Navy established is to prevent or minimize the release of hazardous substances causing substantial danger to present or future human health or the environment, using cost effective measures, without adversely impacting important wildlife habitat in the long term.

Four specific remedial objectives were established.

a. Prevent all biota from contacting contaminated soils that would threaten them.

b. Prevent resuspension and redistribution of the contaminated soils and sediments that would threaten the area flora and fauna.

c. Minimize disturbance of the wetlands consistent with long term protection of flora and fauna.

d. Prevent migration of contaminants into the ground water.

Under the no-response scenario, the primary existing and potential dangers to the public health and the environment are as follows.

a. Migration of sediments contaminated with arsenic, cadmium, copper, lead, selenium, and/or zinc via surface water transport.

b. Biological uptake and accumulation of arsenic, cadmium, copper, lead, selenium, and/or zinc.

c. Direct contact with soils contaminated with arsenic, cadmium, copper, lead, selenium, and/or zinc.

d. Migration of dust contaminated with arsenic, cadmium, copper, lead, selenium, and/or zinc.

On 17 October 1986, the President signed into law the Superfund Amendments and Reauthorization Act of 1986 amending and reauthorizing the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). On 9 July 1987, the EPA issued interim guidance on Compliance with Applicable or Relevant and Appropriate Requirements (ARAR's). As part of the initial feasibility study process the Navy identified Federal and State statutes, regulations, and other authorities with which the Navy may have to comply in responding to the release or the threatened release of hazardous substances. These potential ARAR's were identified through in-house review of previously prepared feasibility studies and consultation with appropriate Federal and State agencies. An analysis of ARAR's was conducted to determine whether each alternative evaluated in detail attained the ARAR's the Navy identified for RASS's 1, 2, 3, and 4. The Statutory ARAR's identified are listed below.

a. The Federal Clean Water Act
b. The Solid Waste Disposal Act
c. The Endangered Species Act
d. The Safe Drinking Water Act
e. Rivers and Harbors Act
f. Executive Order 11,990
g. Executive Order 11,988
h. California Water Code
i. California Fish and Game Code
j. California Public Resources Code
k. California Health and Safety Code

The goals that Section 121(b) of CERCLA, as amended, requires that the Navy attain in selecting a remedial action are: protection of human health and the environment; cost effectiveness; and use of permanent solutions and alternative treatment technologies to the maximum extent practicable. Section 121(a) of CERCLA requires that the Navy select a remedial action that is in accordance, to the maximum extent practicable, with the National Contingency

Plan and which provides for cost effective response. Section 121(d) of CERCLA, as amended, requires that the Navy select a remedial action which, at the completion of the remedial action, attains a level or standard of control (with respect to any hazardous substances that will remain onsite) that will at least attain:

a. Any legally applicable or relevant and appropriate standards, requirements, criteria, or limitations (under the circumstances of the release or threatened release of hazardous substances) under any Federal environmental law;

b. Any legally applicable or relevant and appropriate promulgated standards, requirements, criteria, or limitations (under the circumstances of the release or threatened release of hazardous substances) under any state environmental or facility siting law that are more stringent than any Federal standards, requirements, criteria, or limitations and which have been identified to the Navy in a timely manner.

Section 121(d) of CERCLA, as amended, however, provides that the Navy may select a remedial action meeting the requirements of Section 121(d) of CERCLA, as amended, which does not attain a level or standard of control at least equivalent to an applicable or relevant and appropriate standard, requirement, or criteria, or limitation as required by CERCLA, as amended, if the Navy finds that one or more of the following conditions exists.

a. The remedial action selected is only part of a total remedial action that will attain such level or standard of control when completed.

b. Compliance with such standards, requirements, criteria, or limitations will result in greater risk to human health and the environment than alternative options.

c. Compliance with such standards, requirements, criteria, or limitations is technically impracticable from an engineering perspective.

d. The remedial action selected will attain a standard of performance that is equivalent to that required under the otherwise applicable standards, requirements, criteria, or limitations.

e. With respect to State standards, requirements, criteria, or limitations, the State has not consistently applied (or demonstrated the intention to consistently apply) the standards, requirements, criteria, or limitation in similar circumstances at other remedial actions within the State.

Site-Specific Action Levels

The Navy developed site-specific action levels for remediation of contamination. Two general types of threats were considered: direct contact by intruders on the contaminated sites and contamination of other environmental media by migration of contaminated soils. The Navy identified no currently promulgated criteria or standards for contaminants in soils, except for PCB contaminated soils.

Since no specific criteria or standards were found that address the types of contamination considered in this feasibility study, the extent to which other Federal environmental and public health requirements are applicable or relevant and appropriate to a specific site, and the extent to which other Federal criteria, advisories, and guidance, and State standards are pertinent, were evaluated. In addition to the criteria and standards, the Navy identified five site-specific factors that affected selection of clean-up criteria. The criteria and factors are presented in Table E.3 and E.4, respectively. Criteria and factors for each RASS were evaluated independently to account for the different conditions found on each RASS. Estimated area of clean-up required under each criterion evaluated is presented in Table E.5.

Following review and evaluation of these criteria and factors, decision rules were developed for clean-up required in each RASS. These decision rules are summarized below.

RASS 1. Specific remedial action decision rules developed for RASS 1.

Table E.3

Potential Criteria for Evaluating Scope of Required Remediation

Criterion	Measure of Contamination
Contaminant Content of Soils	Exceeding Highest Reference Level
	Statistically Exceeding Reference Level
	Exceeds MASSA
	Exceeds TTLC
	Exceeds STLC
	Exceeds EP
	Low pH
Direct Contact	
Human Ingestion	Exceeds California DOHS Recommendations
	Soil Ingestion Standards
Bioaccumulation	
Plants	Critical Content
	Statistically Above Reference Areas
	FDA Standards
Animals	
Earthworms	Statistically Above Reference Areas
	FDA Standards
Mice and voles	Statistically Above Reference Areas
	FDA Standard
Clams	Statistically Above Reference Areas
	FDA Standards
Indirect Contact	
Surface Water	Ambient Water Quality Standards
Ground Water	Drinking Water Standards (MCL or MCLG)
Air	California Applied Action Levels
Habitat Quality	Death of Plants or Animals
	Undesirable Change in Biotic Composition
	Extent of Barren Areas

Table E.4

Potential Modifying Factors Considered in Selecting Remediation Criteria

Source of Contamination to Other Areas

Precedent

Presence of Wetlands

Presence of Endangered Species

Topography

1. Active remediation of those areas in which the soil metal content exceeds the TTLC/STLC criterion, modified as follows. Reduce the area of active remediation, accounting for topography and the presence of wetlands and endangered species, to the area in the easterly most portion of the RASS. This would leave approximately seven acres of wetland that exceed the TTLC/STLC criterion undisturbed. Increase the area of active remediation to include those barren areas not contained within the boundaries of the TTLC/STLC criterion.

2. Passive remediation, extensive monitoring with the potential for further active remediation, in areas of contamination not actively remediated.

3. Monitoring, less intensively than in the passive remediation zone, in the remainder of the RASS.

RASS 2. Specific remedial action decision rules developed for RASS 2.

1. Active remediation of those areas in which the soil metal content exceeds the TTLC/STLC criterion. Increase the area of active remediation to include those barren areas not contained within the boundaries of the TTLC/STLC criterion.

2. Passive remediation, extensive monitoring with the potential for further active remediation, in areas of contamination not actively remediated.

3. Monitoring, less intensively than in the passive remediation zone, in the remainder of the RASS.

RASS 3. Specific remedial action decision rules developed for RASS 3.

1. Active remediation of those areas in which the soil metal content exceeds either the TTLC/STLC criterion or the statistically above reference area criterion. Increase the area of active remediation to include a small area containing elevated soil metal concentrations near the Nichols Creek railroad trestle.

2. Passive remediation, extensive monitoring with the potential for further active remediation, in areas of contamination not actively remediated.

3. Monitoring, less intensively than in the passive remediation zone, in the remainder of the RASS.

RASS 4. Specific remedial action decision rules developed for RASS 4.

1. Active remediation of those areas in which the soil metal content exceeds either the TTLC/STLC criterion or the low pH criterion.

2. Passive remediation, extensive monitoring with the potential for further active remediation, in areas of contamination not actively remediated.

3. Monitoring, less intensively than in the passive remediation zone, in the remainder of the RASS.

The above decision criteria were used to estimate the area of remediation, both active and passive, in each RASS. The remediation area is summarized in Table E.6

Alternative Development and Screening

Remedial alternatives that may achieve the environmental goals and specific action levels and are suitable for detailed evaluation were developed in a three-step process. Criteria were first established to evaluate the acceptability of environmental and public health impacts. This step, described above, established relevant and appropriate requirements and other criteria, as appropriate, to define performance requirements and potential human and environmental risks associated with the remedial action. Next, potentially applicable technologies were identified and evaluated for applicability to site ecific contamination problems. Finally, applicable technologies were used to develop comprehensive remedial alternatives which were screened in accordance with established criteria.

Table E.5

Summary of Remediation Area for Selected Potential Criteria

	Area Exceeding Soil Metal Contents of Reference Area	Soil Metal Statistically Higher Than Reference Area	Soil Metal Content Exceeding MASSA	Bioaccumulation of Metals in Plants & Animals	Area of Contamination	Exceeding STLC or TTLC Values	Barren Areas
Rass 1							
572-N	80.03*	19.24	0.19	28.82	31.42	15.40	1.03
571-N	3.90	--	--	0.06	0.06	--	--
571-SF	0.45	--	--	0.02	0.02	--	--
571-SP	0.04	--	--	--	--	--	--
CC	--	--	--	--	--	--	--
CC-SF	--	--	--	--	--	--	--
CC-SP	--	--	--	--	--	--	--
Other-N	0.01	--	--	0.01	0.01	--	--
Other-SF	--	--	--	--	--	--	--
Other-SP	--	--	--	--	--	--	--
Stream	0.99	--	--	0.60	0.60	--	--
SUBTOTAL	85.42	19.24	0.19	29.51	32.11	15.40	1.03
Rass 2							
572-N	9.21	1.61	1.80	1.84	--	2.33	0.67
572-SF	3.06	0.83	1.78	0.56	1.99	1.39	0.56
572-SP	0.31	--	--	--	0.78	0.03	--
SUBTOTAL	12.58	2.44	3.58	2.40	2.77	3.75	1.23

(Continued)

* All values in acres.

Table E.5 (Concluded)

	Area Exceeding Soil Metal Contents of Reference Area	Soil Metal Statistically Higher Than Reference Area	Soil Metal Content Exceeding MASSA	Bioaccumulation of Metals in Plants & Animals	Area of Contamination	Exceeding STLC or TTLC Values	Barren Areas
RASS 3							
573-Other-SP	0.04	--	--	--	--	--	--
573-Other-N	0.66	--	--	0.02	0.02	--	--
573-Other-SF	--	--	--	--	--	--	--
573-SP	0.36	--	0.50	--	0.34	--	--
573-N	3.57	2.87	0.17	2.08	2.92	0.34	--
573-SF	--	--	--	--	--	--	--
574-SP	0.48	0.31	0.50	--	0.31	0.09	--
574-N	1.06	1.05	0.88	0.95	1.41	1.28	--
574-SF	--	--	--	--	--	--	--
575-SP	0.14	--	0.13	Trace	--	--	--
575-N	1.12	0.20	1.72	Trace	0.20	0.09	--
575-SF	0.04	0.01	0.17	0.01	0.01	0.05	--
576-SF	0.10	0.08	0.09	0.02	0.10	0.04	--
576-N	0.01	0.01	Trace	0.03	0.03	--	--
576-SN	0.04	0.04	0.03	0.05	0.08	Trace	--
579D-Other-N	0.47	--	--	--	--	--	--
579D-N	0.54	0.01	0.14	0.54	0.62	Trace	--
579D-SN	0.03	--	--	0.05	0.05	0.01	--
579D-CP	--	--	--	--	--	--	--
579D-CP-SN	--	--	--	0.02	--	0.02	--
SUBTOTAL	8.66	4.53	4.33	3.77	6.09	1.92	--
RASS 4							
581-N	4.88	0.19	2.58	0.08	0.25	0.56	--
581-Other-N	0.43	Trace	--	Trace	Trace	--	--
SUBTOTAL	5.31	0.19	2.58	0.08	0.25	0.56	--
TOTAL	111.97	26.45	10.68	35.76	41.22	21.63	2.26

Table E.6

Remediation Area for Selected Decision Criteria

	Passive Remed. Action in Non-Wetland	Passive Remed. Action in Wetland	Total Passive Remediation	Active Remed. Action in Non-Wetland	Active Remed. Action in Wetland	Total Active Remediation
Rass 1						
572-N	0.05*	22.27	22.32	0.16	8.87	9.03
571-N	--	0.06	0.06	--	--	--
571-SF	--	0.02	0.02	--	--	--
571-SP	--	--	--	--	--	--
CC	--	--	--	--	--	--
CC-SF	--	--	--	--	--	--
CC-SP	--	--	--	--	--	--
Other-N	--	0.01	0.01	--	--	--
Other-SF	--	--	--	--	--	--
Other-SP	--	--	--	--	--	--
Stream	--	0.60	0.60	--	--	--
SUBTOTAL	0.05	22.96	23.01	0.16	8.87	9.03
Rass 2						
572-N	--	0.67	0.67	1.11	1.43	2.54
572-SF	0.27	0.27	0.27	1.40	0.20	1.60
572-SP	--	--	--	0.03	--	0.03
SUBTOTAL	0.27	0.94	0.94	2.54	1.63	4.17

(Continued)

* All areas in acres.

Table E.6 (Concluded)

	Passive Remed. Action in Non-Wetland	Passive Remed. Action in Wetland	Total Passive Remediation	Active Remed. Action in Non-Wetland	Active Remed. Action in Wetland	Total Active Remediation
RASS 3						
573-Other-SP	--	--	--	--	--	--
573-Other-N	0.02	--	0.02	0.03	--	0.03
573-Other-SF	--	--	--	--	--	--
573-SP	--	--	--	--	--	--
573-N	--	0.01	0.01	0.02	2.89	2.91
573-SF	--	--	--	--	--	--
574-SP	--	--	--	0.31	--	0.31
574-N	0.05	0.32	0.37	0.50	0.55	1.05
574-SF	--	--	--	--	--	--
575-SP	--	--	--	--	--	--
575-N	--	--	--	0.09	0.11	0.20
575-SF	--	--	--	--	0.01	0.01
576-SF	0.01	--	0.01	0.08	0.01	0.09
576-N	0.02	--	0.02	--	0.01	0.01
576-SN	0.04	--	0.04	0.03	0.01	0.04
579D-Other-N	--	--	--	--	--	--
579D-N	0.48	--	0.48	Trace	Trace	Trace
579D-SN	0.04	--	0.04	--	0.01	0.01
579D-CP	--	--	--	--	--	--
579D-CP-SN	0.02	--	0.02	Trace	--	Trace
SUBTOTAL	0.68	0.33	1.01	1.06	3.60	4.66
RASS 4						
581-N	0.49	0.01	0.50	0.63	0.24	0.87
581-N-Other-N	--	0.04	0.04	--	--	--
SUBTOTAL	0.49	0.05	0.54	0.63	0.24	0.87
TOTAL	1.49	24.28	25.50	4.39	14.34	18.73

Technology Screening. Twenty four individual technologies were identified and screened for applicability to remediation of the site-specific contamination problems. Of these twenty four technologies, nine were retained for use in the development of remedial action alternatives. Table E.7 lists those technologies considered and those retained for further evaluation.

Alternative Development. Technologies surviving the initial screening process are combined into alternatives addressing site-specific problems. A candidate list of alternatives was developed for each RASS. Alternatives were screened on the basis of public health and environmental impacts, engineering feasibility, and costs. Table E.8 presents a summary of the results of the alternative screening process.

Detailed Evaluation of Alternatives

Alternatives surviving the initial screening process were subjected to detailed evaluation using the criteria and factors presented in Table E.9

Based on the results of the detailed evaluation process, alternatives for each RASS were ranked in order of preference. Each alternative and the respective order of preference are discussed below.

Ranked Order of Alternatives for RASS 1. The ranked order for RASS 1 alternatives is discussed below.

First Alternative. Alternative 1-3C (Excavation/Immobilization/Disposal in an Existing Class III Landfill/Restoration) is considered as the most favorable alternative. Removal of the contaminated soils and sediments from the RASS and treating the soils with a solidification/stabilization process is more reliable than the no action or environmental monitoring alternatives with respect to elimination of migration of metals and long term reduction of the public health and environmental risk.

Among the removal alternatives considered, Alternative 1-3C is the least cost alternative. The next higher cost alternative (Alternative 1-3D) is slightly

Table E.7

Applicability of Remedial Technologies at NWS Concord

Available Technology	Applicable Yes	Applicable No
Recycle/Reuse		x
Waste Minimization		x
Surface Sealing and Capping	x	
Grading and Revegetation	x	
Surface Water Diversion and/or Collection	x	
Containment Barriers		x
Hydraulic Barriers		x
Excavation and Disposal	x	
Waste Biodegradation/Bioreclamation		x
Detoxification		x
Vitrification		x
Soil Flushing	x	
Soil Washing	x	
Contaminant Immobilization	x	
In Situ Contaminant Immobilization	x	
Bottom Sealing		x
Groundwater and Leachate Treatment		x
Waste Destruction		x
Withdrawal Well Networks		x
Flood Proofing	x	
Permeable Treatment Beds		x
Subsurface Collection Drains		x
In Situ Heating		x
In Situ Freezing		x

Table E.8

Summary of Initial Screening of Alternatives

Potential Remedial Alternative	Alternative Description	Positive Impacts		Negative Impacts		Engineering Feasibility	Cost Range (000$)		Selected for Detailed Evaluation
		Environmental	Public Health	Environmental	Public Health		Low	High	
RASS 1									
Alternative 1-1	No Action	None	None	Major	Major	High	63	104	Yes
Alternative 1-2	Environmental Monitoring	Minor	Minor	Major	Major	High	2,598	4,330	Yes
Alternative 1-3A	Excavation/Disposal at Existing Landfills	Major	Major	Major	Minor	High	3,542	5,903	Yes
Alternative 1-3B	Excavation/Disposal at Monofill on NWS Concord	Major	Major	Major	Minor	Low	3,075	5,125	No
Alternative 1-3C	Excavation/Immobilization/Disposal at Existing Landfills	Major	Major	Major	Minor	Moderate	2,517	4,194	Yes
Alternative 1-3D	Excavation/Immobilization/Disposal at Monofill on NWS Concord	Major	Major	Major	Minor	Moderate	3,675	6,125	Yes
Alternative 1-3E	Excavation/Soil Washing/Disposal at Existing Landfills	Major	Major	Major	Minor	Moderate	4,819	8,032	Yes
Alternative 1-3F	Excavation/Soil Washing/Disposal at Monofill on NWS Concord	Major	Major	Major	Minor	Moderate	5,497	9,162	Yes
Alternative 1-4A	Source Isolation/Soil Cap	Moderate	Moderate	Severe	Minor	High	2,100	3,500	No
Alternative 1-4B	Source Isolation/RCRA Cap	Moderate	Moderate	Severe	Minor	Moderate	2,925	4,875	No[1]
Alternative 1-5A	On Site Restoration	Major	Major	Minor	Minor	High	3,573	5,904	Yes
Alternative 1-5B	Off Site Restoration	Major	Major	Moderate	Minor	High	2,327	3,878	No
Alternative 1-6A	In Situ Stabilization	Moderate	Moderate	Severe	Minor	Low	2,946	4,909	No
Alternative 1-6B	Soil Flushing	Moderate	Moderate	Moderate	Minor	Low	4,316	7,193	No
RASS 2									
Alternative 2-1	No Action	None	None	Major	Major	High	42	70	Yes
Alternative 2-2	Environmental Monitoring	Minor	Minor	Major	Major	High	765	1,274	Yes
Alternative 2-3A	Excavation/Disposal at Existing Landfills	Major	Major	Major	Minor	High	2,360	3,933	Yes
Alternative 2-3B	Excavation/Disposal at Monofill on NWS Concord	Major	Major	Major	Minor	Low	2,252	3,753	No
Alternative 2-3C	Excavation/Immobilization/Disposal at Existing Landfills	Major	Major	Major	Minor	Moderate	1,642	2,737	Yes
Alternative 2-3D	Excavation/Immobilization/Disposal at Monofill on NWS Concord	Major	Major	Major	Minor	Moderate	2,643	4,405	Yes
Alternative 2-3E	Excavation/Soil Washing/Disposal at Existing Landfills	Major	Major	Major	Minor	Moderate	3,150	5,249	Yes
Alternative 2-3F	Excavation/Soil Washing/Disposal at Monofill on NWS Concord	Major	Major	Major	Minor	Moderate	3,837	6,395	Yes
Alternative 2-4A	Source Isolation/Soil Cap	Moderate	Moderate	Severe	Minor	High	1,044	1,739	No
Alternative 2-4B	Source Isolation/RCRA Cap	Moderate	Moderate	Severe	Minor	High	1,463	2,438	No[1]
Alternative 2-5A	On-Site Restoration	Major	Major	Minor	Minor	High	2,412	4,020	Yes
Alternative 2-5B	Off-Site Restoration	Major	Major	Moderate	Minor	High	1,187	1,979	No
Alternative 2-6A	In Situ Stabilization	Moderate	Moderate	Severe	Minor	Low	1,950	3,249	No
Alternative 2-6B	Soil Flushing	Moderate	Moderate	Moderate	Minor	Low	2,804	4,673	No

(Continued)

[1] Incorporated into other alternative.

Table E.8 (Concluded)

Potential Remedial Alternative	Alternative Description	Positive Impacts: Environmental	Positive Impacts: Public Health	Negative Impacts: Environmental	Negative Impacts: Public Health	Engineering Feasibility	Cost Range (000$): Low	Cost Range (000$): High	Selecte for Detai Evaluati
RASS 3									
Alternative 3-1	No Action	None	None	Major	Major	High	117	194	Yes
Alternative 3-2	Environmental Monitoring	Minor	Minor	Major	Major	High	1,110	1,849	Yes
Alternative 3-3A	Excavation/Disposal at Existing Landfills	Major	Major	Major	Minor	High	2,233	3,722	Yes
Alternative 3-3B	Excavation/Disposal at Monofill on NWS Concord	Major	Major	Major	Minor	Low	2,259	3,765	No
Alternative 3-3C	Excavation/Immobilization/Disposal at Existing Landfills	Major	Major	Major	Minor	Moderate	1,657	2,762	Yes
Alternative 3-3D	Excavation/Immobilization/Disposal at Monofill on NWS Concord	Major	Major	Major	Minor	High	2,680	4,467	Yes
Alternative 3-3E	Excavation/Soil Washing/Disposal at Existing Landfills	Major	Major	Major	Minor	Moderate	3,277	5,462	Yes
Alternative 3-3F	Excavation/Soil Washing/Disposal at Monofill on NWS Concord	Major	Major	Major	Minor	Moderate	3,964	6,607	Yes
Alternative 3-4A	Source Isolation/Soil Cap	Moderate	Moderate	Severe	Minor	Low	1,611	2,684	No
Alternative 3-4B	Source Isolation/RCRA Cap	Moderate	Moderate	Severe	Minor	Low	2,285	3,808	No
Alternative 3-6A	In Situ Stabilization	Moderate	Moderate	Severe	Minor	Low	1,964	3,273	No
Alternative 3-6B	Soil Flushing	Moderate	Moderate	Moderate	Minor	Low	2,957	4,927	No
RASS 4									
Alternative 4-1	No Action	None	None	Moderate	Moderate	High	40	67	Yes
Alternative 4-2	Environmental Monitoring	Minor	Moderate	Moderate	Moderate	High	406	677	Yes
Alternative 4-3A	Excavation/Disposal at Existing Landfills	Major	Moderate	Minor	Minor	High	199	332	Yes
Alternative 4-3B	Excavation/Disposal at Monofill on NWS Concord	Major	Moderate	Minor	Minor	Low	856	1,422	No
Alternative 4-3C	Excavation/Immobilization/Disposal at Existing Landfills	Major	Moderate	Minor	Minor	Moderate	198	329	Yes
Alternative 4-3D	Excavation/Immobilization/Disposal at Monofill on NWS Concord	Major	Moderate	Minor	Minor	Moderate	931	1,552	Yes
Alternative 4-3E	Excavation/Soil Washing/Disposal at Existing Landfills	Major	Moderate	Minor	Minor	Moderate	496	827	Yes
Alternative 4-3F	Excavation/Soil Washing/Disposal at Monofill on NWS Concord	Major	Moderate	Minor	Minor	Moderate	1,202	2,003	Yes
Alternative 4-4A	Source Isolation/Soil Cap	Moderate	Moderate	Minor	Minor	High	144	240	Yes
Alternative 4-4B	Source Isolation/RCRA Cap	Moderate	Moderate	Minor	Minor	High	208	347	Yes
Alternative 4-6A	In Situ Stabilization	Moderate	Moderate	Minor	Minor	Low	257	428	No
Alternative 4-6B	Soil Flushing	Moderate	Moderate	Minor	Minor	Low	477	794	No

1 Incorporated into other alternative.

Table E.9

Detailed Evaluation Criteria

- Technical Feasibility
  - Performance
  - Reliability
  - Implementability
  - Safety
  - Level of remediation achievable

- Environmental Considerations
  - Beneficial effects
  - Adverse effects

- Institutional Considerations
  - Conformance to the ARARs
  - Permitting requirements
  - Legal constraints, if any
  - Cultural resources

- Public Health Considerations
  - Minimization of exposure
  - Minimization of chemical releases
  - Releases that will not be minimized
  - Exposures during remedial action
  - Exposures after remedial action

- Cost
  - Capital cost
  - Operation and maintenance costs
  - Present worth cost

higher in cost because of the long term commitment to operation of a monofill on NWS Concord.

Disposal of the solidified/stabilized materials in an existing Class III landfill will require approval of State regulatory agencies. Classification of the treated soils will depend on the outcome of laboratory and pilot scale testing. Alternative 1-3C uses a Section 121(b)(1) preferred technology and includes a wetland restoration element.

Second Alternative. Alternative 1-3A (Excavation/Disposal at Existing Class I Landfill/Restoration is considered as the second alternative. A primary consideration in evaluation of Alternative 1-3A is its high present worth and the transportation of large quantities of Class I materials over public roadways. Although the transportion considerations could be largely minimized through the use of rail transport, costs are considerably higher than those associated with Alternatives 1-3C or 1-3D. However, competitive bidding processes could reduce the cost of this alternative by approximately 12 percent. Another consideration in ranking this alternative was the institutional concern over the consumption of Class I landfill space that can be utilized for higher priority waste materials. State regulatory personnel have expressed concern over the use of existing landfills for this purpose. Alternative 1-3A does not use a Section 121(b)(1) preferred technology; however, this alternative includes a wetland restoration element.

Third Alternative. Alternative 1-3D (Excavation/Immobilization/Disposal at Monofill on NWS Concord/Restoration) is considered as the third preferred alternative. This alternative is comparable to Alternative 1-3C except that it requires construction of a monofill on NWS Concord. Although the solidification/stabilization of the soils would limit the mobility of the arsenic and heavy metals, because of geological considerations and uncertainties over the long term stability of solidified/stabilized soils, the monofill would be constructed and operated to Class I engineering standards, thus increasing the cost of this alternative. Allocation of approximately 13 acres on NWS Concord for use as the monofill site would be required. Alternative 1-3D uses a Section 121(b)(1) preferred technology and includes a wetland restoration element.

Fourth Alternative. Alternatives 1-3E (Excavation/Soil Washing/Disposal at Existing Landfill/Restoration) and 1-3F (Excavation/Soil Washing/Disposal at Monofill on NWS Concord/Restoration) are considered jointly as the fourth alternative. Primary considerations in ranking these alternatives were the high cost and relatively unproven soil washing technology upon which both depend. Alternatives 1-3E and 1-3F use a Section 121(b)(1) preferred technology and include a wetland restoration element.

Fifth Alternative. Alternative 1-2 (Environmental Monitoring) is ranked fifth and is preferred over the no action alternative. The soils and sediments found on RASS 1 have been contaminated with high concentrations of arsenic and heavy metals. Bioaccumulation and migration of contaminants have been documented. Although the removal alternatives provide significantly greater protection of the public health and environment, an absolute minimal response would include implementation of an environmental monitoring program.

Sixth Alternative. Alternative 1-1 (No Action) is ranked last because of the reasons described by Lee et al. (1986).

<u>Ranked Order of Alternatives for RASS 2</u>. The ranked order for RASS 2 alternatives is discussed below.

First Alternative. Alternative 2-3C (Excavation/Immobilization/Disposal in an Existing Class III Landfill/Restoration) is considered as the most favorable alternative. Removal of the contaminated soils and sediments from the RASS and treating the soils with a solidification/stabilization process is more reliable than the no action or environmental monitoring alternatives with respect to elimination of migration of metals and long term reduction of the public health and environmental risk.

Among the removal alternatives considered, Alternative 2-3C is the least cost alternative. The next higher alternative (Alternative 2-3D) is higher in cost because of the long term commitment to operation of a monofill on NWS Concord.

Disposal of the solidified/stabilized materials in an existing Class III landfill will require approval of State regulatory agencies. Classification of the treated soils will depend on the outcome of laboratory and pilot scale testing. Alternative 2-3C uses a Section 121(b)(1) preferred technology and includes a wetland restoration element.

Second Alternative. Alternative 2-3A (Excavation/Disposal at Existing Class I Landfill/Restoration) is considered as the second alternative. A primary consideration in evaluation of Alternative 2-3A is its high present worth and the transportation of large quantities of Class I materials over public roadways. Although the transportation considerations could be largely minimized through the use of rail transport, costs are considerably higher than those associated with Alternatives 2-3C or 2-3D. However, competitive bidding processes could reduce the cost of this alternative by approximately 12 percent. Another consideration in ranking this alternative is the institutional concern over the consumption of Class I landfill space that can be utilized for higher priority waste materials. State regulatory personnel have expressed concern over the use of existing landfills for this purpose. Alternative 2-3A does not use a Section 121(b)(1) preferred technology; however, it does include a wetland restoration element.

Third Alternative. Alternative 2-3D (Excavation/Immobilization/Disposal at Monofill on NWS Concord/Restoration) is considered as the third preferred alternative. This alternative is comparable to Alternative 2-3C except that it requires construction of a monofill on NWS Concord. Although the solidification/stabilization of the soils would limit the mobility of the arsenic and heavy metals, because of geological considerations and uncertainties over the long term stability of solidified/stabilized soils, the monofill would be constructed and operated to Class I engineering standards, thus increasing the cost of this alternative. Allocation of approximately 10 acres on NWS Concord for use as the monofill site would be required. Alternative 2-3D uses a Section 121(b)(1) preferred technology and includes a wetland restoration element.

Fourth Alternative. Alternatives 2-3E (Excavation/Soil Washing/Disposal at Existing Landfill/Restoration) and 2-3F (Excavation/Soil Washing/Disposal at

Monofill on NWS Concord/Restoration) are considered jointly as the fourth alternative. Primary considerations in ranking these alternatives were the high cost and relatively unproven soil washing technology upon which both depend. Alternatives 2-3E and 2-3F use a Section 121(b)(1) preferred technology and include a wetland restoration element.

Fifth Alternative. Alternative 2-2 (Environmental Monitoring) is ranked fifth and is preferred over the no action alternative. The soils and sediments found on RASS 2 have been contaminated with high concentrations of heavy metals. Bioaccumulation and migration of contaminants have been documented. Although the removal alternatives provide significantly greater protection of the public health and environment, an absolute minimal response would include implementation of an environmental monitoring program.

Sixth Alternative. Alternative 2-1 (No Action) is ranked last because of the reasons described by Lee et al. (1986,1988a).

<u>Ranked Order of Alternatives for RASS 3</u>. The ranked order for RASS 3 alternatives is discussed below.

First Alternative. Alternative 3-3C (Excavation/Immobilization/Disposal in an Existing Class III Landfill/Revegetation) is considered as the most favorable alternative. Removal of the contaminated soils and sediments from the RASS and treating the soils with a solidification/stabilization process is more reliable than the no action or environmental monitoring alternatives with respect to elimination of migration of metals and long term reduction of the public health and environmental risk.

Among the removal alternatives considered, Alternative 3-3C is the least cost alternative. The next higher alternative (Alternative 3-3A) is slightly higher in cost. The cost difference is probably not significant within the limitation of the cost estimating methodology.

Disposal of the solidified/stabilized materials in an existing Class III landfill will require approval of State regulatory agencies. Classification

of the treated soils will depend on the outcome of laboratory and pilot scale testing. Alternative 3-3C uses a Section 121(b)(1) preferred technology.

Second Alternative. Alternative 3-3A (Excavation/Disposal at Existing Landfill/Revegetation) is considered as the second alternative. A primary consideration in evaluation of Alternative 3-3A is its high present worth and the transportation of large quantities of Class I materials over public roadways. Transportation considerations could be largely minimized through the use of rail transport. Competitive bidding processes could reduce the cost of this alternative by approximately nine percent. Another consideration in ranking this alternative was the institutional concern over the consumption of Class I landfill space that can be utilized for higher priority waste materials. State regulatory personnel have expressed concern over the use of existing landfills for this purpose. Alternative 3-3A does not use a Section 121(b)(1) preferred technology.

Third Alternative. Alternative 3-3D (Excavation/Immobilization/Disposal at Monofill on NWS Concord Revegetation) is considered as the third preferred alternative. This alternative is comparable to Alternative 3-3C except that it requires construction of a monofill on NWS Concord. Although the solidification/stabilization of the soils would limit the mobility of the heavy metals, because of geological considerations and uncertainties over the long term stability of solidified/stabilized soils, the monofill would be constructed and operated to Class I engineering standards, thus increasing the cost of this alternative. Allocation of approximately 11 acres on NWS Concord for use as the monofill site would be required. Alternative 3-3D uses a Section 121(b)(1) preferred technology.

Fourth Alternative. Alternatives 3-3E (Excavation/Soil Washing/Disposal at Existing Landfill Revegetation) and 3-3F (Excavation/Soil Washing/Disposal at Monofill on NWS Concord/Restoration) are considered jointly as the fourth alternative. Primary considerations in ranking these alternatives were the high cost and relativly unproven soil washing technology upon which both depend. Alternatives 3-3E and 3-3F use a Section 121(b)(1) preferred technology.

Fifth Alternative. Alternative 3-2 (Environmental Monitoring) is ranked fifth and is preferred over the no action alternative. The soils and sediments found on RASS 3 have been contaminated with high concentrations of heavy metals. Bioaccumulation and migration of contaminants have been documented. Although the removal alternatives provide significantly greater protection of the public health and environment, an absolute minimal response would include implementation of an environmental monitoring program.

Sixth Alternative. Alternative 3-1 (No Action) is ranked last because of the adverse environmental impacts described by Lee et al. (1986, 1988).

<u>Ranked Order of Alternatives for RASS 4</u>. The ranked order of alternatives for RASS 4 is discussed below.

First Alternative. Alternative 4-3C (Excavation/Immobilization/Disposal in an Existing Class III Landfill) is considered as the most favorable alternative. Removal of the contaminated soils from the RASS and treating the soils with a solidification/stabilization process is more reliable than the no action or environmental monitoring alternatives with respect to elimination of migration of metals and long term reduction of the public health and environmental risk.

Among the removal alternatives considered, Alternative 4-3C is the least cost alternative. The next higher alternative (Alternative 4-3A) is slightly higher in cost because of the higher transportation costs to a Class I landfill. The cost difference is probably not significant within the limitation of the cost estimating methodology.

Disposal of the solidified/stabilized materials in an existing Class III landfill will require approval of State regulatory agencies. Classification of the treated soils will depend on the outcome of laboratory and pilot scale testing. Alternative 4-3C uses a Section 121(b)(1) preferred technology.

Second Alternative. Alternative 4-3A (Excavation/Disposal at Existing Landfills) is considered as the second alternative. A primary consideration in evaluation of Alternative 4-3A is the transportation of large quantities of Class I materials over public roadways. Transportation considerations could

be largely minimized through the use of rail transport. Competitive bidding processes could reduce the cost of this alternative by approximately nine percent. Another consideration in ranking this alternative was the institutional concern over the consumption of Class I landfill space that can be utilized for higher priority waste materials. State regulatory personnel have expressed concern over the use of existing landfills for this purpose. Alternative 4-3A does not use a Section 121(b)(1) preferred technology.

Third Alternative. Alternative 4-4B (Source Isolation/RCRA Cap) is considered to be the third alternative. Source isolation using a RCRA cap is a proven technology that can be implemented under the conditions existing on RASS 4. The primary rational for ranking Alternative 4-4B (Source Isolation/RCRA Cap) as the third alternative is relatively low cost and the added protection provided against contaminant migration into groundwater. Although migration of contaminants into the ground water has not been demonstrated, Alternative 4-4B provides additional protection against such migration. This alternative is more reliable than Alternative 4-4A. This added reliability is attained with a nominal increase in cost. Alternative 4-4B is ranked behind Alternatives 4-3C because of reliability concerns related to leaving contamination onsite.

Fourth Alternative. Alternative 4-4A (Source Isolation/Soil Cap) is considered as the fourth alternative. Alternative 4-4A is ranked as the fourth alternative primarily because of its relatively low cost. Alternative 4-4A is considered to be slightly less reliable than Alternative 4-4B. Contamination is left on site and the RCRA cap (Alternative 4-4B) provides additional protection against contaminant migration at nominally higher cost.

Fifth Alternative. Alternative 4-3D (Excavation/Immobilization/Disposal at Monofill on NWS Concord) is considered as the fifth preferred alternative. This alternative is comparable to Alternative 4-3C except that it requires construction of a monofill on NWS Concord. Although the solidification/stabilization of the soils would limit the mobility of the heavy metals, because of geological considerations and uncertainties over the long term stability of solidified/stabilized soils, the monofill would be constructed and operated to Class I engineering standards, thus increasing the cost of

this alternative. Allocation of approximately 11 acres on NWS Concord for use as the monofill site would be required. Alternative 4-3D uses a Section 121(b)(1) preferred technology.

Sixth Alternative. Alternatives 4-3E (Excavation/Soil Washing/Disposal at Existing Landfill) and 4-3F (Excavation/Soil Washing/Disposal at Monofill on NWS Concord) are considered jointly as the sixth alternative. Primary considerations in ranking these alternatives were the high cost and relatively unproven soil washing technology upon which both depend. Alternatives 4-3F and 4-3F use a Section 121(b)(1) preferred technology.

Seventh Alternative. Alternative 4-2 (Environmental Monitoring) is ranked seventh and is preferred over the no action alternative. The soils and sediments found on RASS 4 have been contaminated with high concentrations of heavy metals. Bioaccumulation and migration of contaminants have been documented. Although the removal alternatives provide significantly greater protection of the public health and environment, an absolute minimal response would include implementation of an environmental monitoring program.

Eighth Alternative. Alternative 4-1 (No Action) is ranked last because of the adverse environmental impacts described by Lee et al. (1986, 1988a).

Summary

The Navy has conducted a five step feasibility study. First, the Navy has characterized the problem and developed appropriate clean-up criteria. Second, the Navy has evaluated available technologies for applicability to solving identified problems. Third, the Navy developed alternative remedial actions and performed a screening based on engineering feasibility, environmental and public health, and cost factors. Fourth, the Navy performed a detailed evaluation of those alternatives surviving the initial screening process using the following evaluation factors: technical feasibility, environmental analysis, institutional analysis, public health analysis, and costs. Fifth, the Navy has ranked the alternatives in order of preference. Tables E.10 through E.13 present the summary of alternatives in ranked order.

Table E.10

Summary of Detailed Evaluation for RASS 1 Alternatives

Rank Order	Alternative	Technical Feasibility Rating	Environmental Impacts Rating	Institutional Requirements Rating	Public Health Requirements Rating	Cost* Analysis ($ Millions)
1	1-3C: Excavation/Immobilization/ Disposal in Existing Landfills/Restoration	High	High	Moderate	High	5.677
2	1-3A: Excavation/Disposal in Existing Landfills/Restoration	High	High	High	High	6.998
3	1-3D: Excavation/Immobilization/ Disposal in Monofill on NWS Concord/Restoration	High	High	Moderate	High	7.455
4	1-3E: Excavation/Soil Washing/ Disposal in Existing Landfills/Restoration	Moderate	Moderate	Low	High	9.727
4	1-3F: Excavation/Soil Washing/ Disposal in Monofill on NWS Concord/Restoration	Moderate	Moderate	Low	High	9.927
5	1-2: Environmental Monitoring	Low	Low	Low	Low	1.656
6	1-1: No Action	Low	Low	Low	Low	0.193

* Present worth calculated at 10 percent for 30 years.

Table E.11

Summary of Detailed Evaluation for RASS 2 Alternatives

Rank Order	Alternative	Technical Feasibility Rating	Environmental Impacts Rating	Institutional Requirements Rating	Public Health Requirements Rating	Cost* Analysis ($ Millions)
1	2-3C: Excavation/Immobilization Disposal in Existing Landfills/Restoration	High	High	Moderate	High	2.889
2	2-3A: Excavation/Disposal in Existing Landfills/Restoration	High	High	High	High	5.069
3	2-3D: Excavation/Immobilization/ Disposal in Monofill on NWS Concord/Restoration	High	High	Moderate	High	4.836
4	2-3E: Excavation/Soil Washing/ Disposal in Existing Landfills/Restoration	Moderate	Moderate	Low	High	5.655
4	2-3F: Excavation/Soil Washing/ Disposal in Monofill on NWS Concord/Restoration	Moderate	Moderate	Low	High	5.925
5	2-2: Environmental Monitoring	Low	Low	Low	Low	0.543
6	2-1: No Action	Low	Low	Low	Low	0.161

* Present worth calculated at 10 percent for 30 years.

Table E.12

Summary of Detailed Evaluation for RASS 3 Alternatives

Rank Order	Alternative	Technical Feasibility Rating	Environmental Impacts Rating	Institutional Requirements Rating	Public Health Requirements Rating	Cost* Analysis ($ Millions)
1	3-3C: Excavation/Immobilization/ Disposal in Existing Landfills	High	High	Moderate	High	2.081
2	3-3A: Excavation/Disposal in Existing Landfills	High	High	High	High	2.636
3	3-3D: Excavation/Immobilization/ Disposal in Monofill on NWS Concord	High	High	Moderate	High	3.762
4	3-3E: Excavation/Soil Washing/ Disposal in Existing Landfills	Moderate	Moderate	Low	High	3.061
4	3-3F: Excavation/Soil Washing/ Disposal in Monofill on NWS Concord	Moderate	Moderate	Low	High	3.372
5	3-2: Environmental Monitoring	Low	Low	Low	Low	0.654
6	3-1: No Action	Low	Low	Low	Low	0.168

* Present worth calculated at 10 percent for 30 years.

Table E.13

Summary of Detailed Evaluation for RASS 4 Alternatives

Rank Order	Alternative	Technical Feasibility Rating	Environmental Impacts Rating	Institutional Requirements Rating	Public Health Requirements Rating	Cost* Analysis ($ Millions)
1	4-3C: Excavation/Immobilization/ Disposal in Existing Landfills	High	High	Moderate	High	0.931
2	4-3A: Excavation/Disposal in Existing Landfills	High	High	High	High	0.940
3	4-4B: Source Isolation/RCRA Cap	Moderate	Moderate	Moderate	High	1.163
4	4-4A: Source Isolation/Soil Cap	Moderate	Moderate	Moderate	High	0.995
5	4-3D: Excavation/Immobilization/ Disposal in Monofill on NWS Concord	High	High	Moderate	High	2.524
6	4-3E: Excavation/Soil Washing/ Disposal in Existing Landfills	Moderate	Moderate	Low	High	1.224
6	4-3F: Excavation/Soil Washing/ Disposal in Monofill on NWS Concord	Moderate	Moderate	Low	High	1.721
7	4-2: Environmental Monitoring	Low	Low	Low	Low	0.349
8	4-1: No Action	Low	Low	Low	Low	0.150

* Present worth calculated at 10 percent for 30 years.

1.0 INTRODUCTION

1.1 Background

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), establishes a national program for responding to releases of hazardous substances into the environment. The operational centerpiece of this program is the National Oil and Hazardous Substances Contingency Plan (NCP) originally promulgated under section 311 of the Federal Water Pollution Control Act and revised under section 105 of CERCLA.

Until 1987, response to the release, and the threatened release, of hazardous substances at abandoned sites on the Naval Weapons Station, Concord (NWS Concord), was conducted through the Navy Assessment and Control of Installation Pollutants (NACIP) Program. The NACIP Program had three (3) phases: Initial Assessment, Confirmation, and Corrective Measures. Initial Assessment involved the collection and evaluation of existing information about the release, and the threatened release, of hazardous substances at abandoned sites. Confirmation involved the verification and characterization of the release, and the threatened release, of hazardous substances. Corrective Measures involved removal and remedial action.

Since 1987, the response to the release, and the threatened release, of hazardous substances at abandoned sites on the NWS Concord has been conducted through the Installation Restoration (IR) Program. The IR Program has five (5) phases: Preliminary Assessment, Site Investigation, Remedial Investigation, Feasibility Study, and Remedial Action.

The Initial Assessment Study (IAS) conducted at the NWS Concord identified thirteen (13) sites for further investigation in a Confirmation Study (Ecology and Environment 1985). A Confirmation Study (CS) on nine (9) of the thirteen (13) sites was conducted in 1984 (Anderson Geotechnical 1984). The CS sites included: AA (IAS Site 4), AB (IAS Site 5), G-1 (IAS Site 26), K-2 (IAS Site 25), KS (IAS Site 3), CP (IAS Site 6), Burn Area (IAS Site 13), Black Pit at Red Rock (IAS Site 16), and Kinne Boulevard Wells (IAS Site 14).

The CS confirmed the presence of high concentrations of arsenic and/or heavy metals in soil in the AA, AB, G-1, K-2, KS, and CP areas.

The findings presented in the CS triggered the conduct of a Remedial Investigation (RI) in areas AA, AB, G-1, K-2, KS, and CP. The RI (Lee et al. 1986) and subsequent studies (Lee et al. 1988, Lee, Cullinane, and O'Neil 1988) provided a detailed assessment of the horizontal and vertical extent of contamination in the soils and the extent of contamination of plants and animals at these sites. In addition, a new area (ES) was found to have high concentrations of heavy metals in soils. The findings presented in the RI (Lee et al. 1986) triggered the preparation of this Feasibility Study (FS).

This FS covers those areas identified as AA, AB, G-1, K-2, KS, ES, and CP. The general locations of these areas are shown on Plate 1.1. This FS includes wetland, transition, and upland contaminated areas located on Parcels 571, 572, 573, 574, 575, 576, 579D, and 581 of NWS Concord. Consideration is also given to contamination known to exist on non-Navy property located adjacent to these parcels. Other areas of NWS Concord identified for additional study in the IAS (Ecology and Environment 1983) and CS (Anderson Geotechnical 1984) are the subject of separate ongoing remedial investigations.

1.2 Primary Source Documents

The following documents provide general guidance on the preparation of a FS.

a. US Environmental Protection Agency. 1985. "Guidance on Feasibility Studies Under CERCLA," EPA/540/G-85/003, Washington, DC.

b. US Environmental Protection Agency. 1984b. "National Oil and Hazardous Substances Pollution Contingency Plan (NCP)," 40 CFR 300 et seq, Washington, DC.

c. Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA).

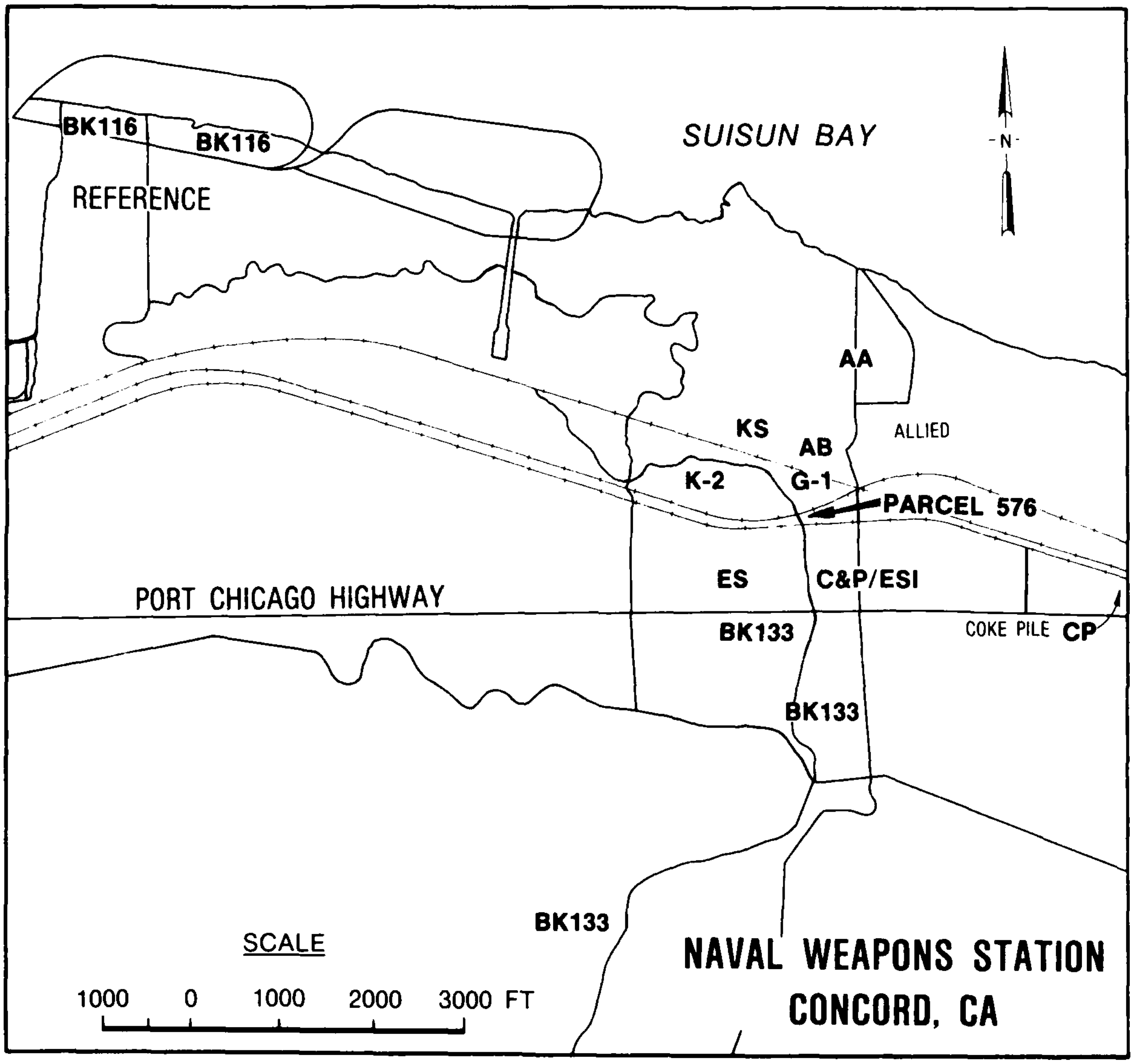

Plate 1.1 General areas of concern at Naval Weapons Station Concord (Lee et al. 1986)

The following documents are referenced for additional detailed background information concerning the extent of contamination on NWS Concord.

a. Ecology and Environment, Inc. 1983. "Initial Assessment Study of Naval Weapons Station, Concord, California," NEESA 13-013, Naval Energy and Environmental Support Activity, Port Hueneme, CA.

b. Anderson Geotechnical Consultants, Inc. 1984. "Confirmation Study Report 2 NWS Concord (Draft)," Department of the Navy, Naval Facilities Engineering Command, San Bruno, CA.

c. Lee et al. 1985. "Assessment of Damage to Natural Resources at Naval Weapons Station, Concord (Final Draft Report)," US Army Engineer Waterways Experiment Station, Miscellaneous Paper EL-85-_, Vicksburg, MS.

d. Lee et al. 1986. "Remedial Investigation of Contaminant Mobility at Naval Weapons Station, Concord (Final Report)," US Army Engineer Waterways Experiment Station, Miscellaneous Paper EL-86-2, Vicksburg, MS.

e. Lee et al. 1988a. "Remedial Investigation of Contaminant Mobility at Naval Weapons Station, Concord, California, Appendix 2.5, 1986/1987 Data," US Army Engineer Waterways Experiment Station, Miscellaneous Paper EL-86-2, Vicksburg, MS.

f. US Navy. 1987. "Conceptual Plans for Additional Investigation of Potential Surface Water and Groundwater Contamination on Parcels 571, 572, 573, 574, 575, 576, 579D, and 581 on the Naval Weapons Station, Concord, California," Department of the Navy submittal to the State of California Regional Water Quality Control Board, 5 October 1987, Naval Facilities Engineering Command, San Bruno, CA.

g. Lutton, R. J., Bennett, R. D., and McAneny, C. C. 1987. "Suitability of Sites for Hazardous Waste Disposal, Concord Naval Weapons Station, Concord, California," Miscellaneous Paper GL-87-28, US Army Engineer Waterways Experiment Station, Vicksburg, MS.

Other sources of information are referenced throughout the Feasibility Study and listed in Section 9, References.

In addition to these sources of information, this volume is to be read in conjunction with the following companion documents.

a. Lee, C. R., Cullinane, M. S., and O'Neil, L. J. 1988. "Feasibility Study of Contamination Remediation at Naval Weapons Station, Concord, California, Vol. III: Figures," Draft Final Report, US Army Engineer Waterways Experiment Station, Miscellaneous Paper EL-86-3, Vicksburg, MS.

b. O'Neil, L. J. 1988. "Feasibility Study of Contamination Remediation at Naval Weapons Station, Concord, California, Vol. II: Biological Assessment," US Army Engineer Waterways Experiment Station, Miscellaneous Paper EL-86-3, Vicksburg, MS.

c. US Navy. 1987. "Conceptual Plans for Additional Investigation of Potential Surface Water and Groundwater Contamination on Parcels 571, 572, 573, 574, 575, 576, 579D, and 581 on the Naval Weapons Station, Concord, California," Department of the Navy submittal to the State of California Regional Water Quality Control Board, 5 October 1987, Naval Facilities Engineering Command, San Bruno, CA.

Finally, the term "Figure" is and used to refer to those figures contained in Volume III of the FS (Lee, Cullinane, O'Neil 1988); the term "Plate" is used to refer to those figures contained within this volume of the FS; and the term "Drawing" is used to refer to those figures attached to the U.S. Navy submittal to the Regional Water Quality Control Board (US Navy 1987).

1.3 Purpose

The purpose of this FS is to identify, select, and evaluate remedial action alternatives for application at NWS Concord, based on technological, public health, institutional, environmental, and cost factors. In addition, an appropriate, cost-effective solution will be recommended.

1.4 Organization of Report

This report is organized into nine major sections:

a. Section 2.0. Existing Conditions;

b. Section 3.0. Contamination Assessment and Identification of Applicable or Relevant and Appropriate Requirements;

c. Section 4.0. Screening of Remedial Action Technologies;

d. Section 5.0 Remedial Action Alternative Development and Initial Screening;

e. Section 6.0. Detailed Description of Alternatives;

f. Section 7.0. Detailed Evaluation of Remedial Alternatives;

g. Section 8.0. Ranking of Alternatives;

h. Section 9.0. References; and

i. Section 10.0. Subject Index.

Three appendices are also included.

a. Appendix A. Breakdown of Major Facilities, Construction Components, and Quantities for Remedial Alternatives;

b. Appendix B. Detailed Breakdown of Capital Cost Estimates; and

c. Appendix C. Detailed Breakdown of Operation and Maintenance Cost Estimates.

2.0 EXISTING CONDITIONS

This Section of the Feasibility Study presents a brief overview of background information related to NWS Concord. Section 2.1 discusses site background information including the location, topography, climatology, geology, soils, hydrology, and land use. Section 2.2 briefly discusses the nature and extent of contamination at NWS Concord. Section 2.3 discusses previous and on going investigations and response actions at the NWS Concord.

2.1 Site Background Information

2.1.1 Location. NWS Concord is located in the north-central portion of Contra Costa County in the San Francisco Bay Area of California. The station is the major ammunition transshipment port on the west coast for the Department of the Navy. It is approximately 30 miles northeast of San Francisco and has, as part of its boundary, Suisun Bay on the north (Figures 1 and 2 and Plate 2.1). The station is bordered on the south and west by the City of Concord, which has a population slightly in excess of 100,000 residents (Ecology and Environment 1983). NWS Concord encompasses nearly 13,000 of land consisting of three land holdings: the Tidal Area, the Inland Areas (linked by a narrow Navy-owned rail and road corridor) near the City of Concord, and a radiography facility located at Pittsburg, California.

The Tidal Area is divided between mainland and islands as shown in Table 2.1. All but a few hundred of the approximately 7,650 acres in the Tidal Area are covered by the Explosive Quantity-Distance Separation Arcs generated by the three explosives handling piers. The piers and almost all of the other facilities in the Tidal Area are located on the original property of the Naval Magazine, Port Chicago. Other facilities include a barge pier, a 525-rail car barricaded siding complex, two rail holding yards, facilities for ammunition segregation and transfer, and warehouses and support buildings. Navy-owned Tidal Area property includes seven islands in Suisun Bay: Freeman, Ryer, Snag, Middle Ground and Roe islands, and the two islets which make up the Seal Islands. These islands account for a total of 1,571 acres. Approximately 3,230 acres in the Tidal Area are leased for agricultural purposes.

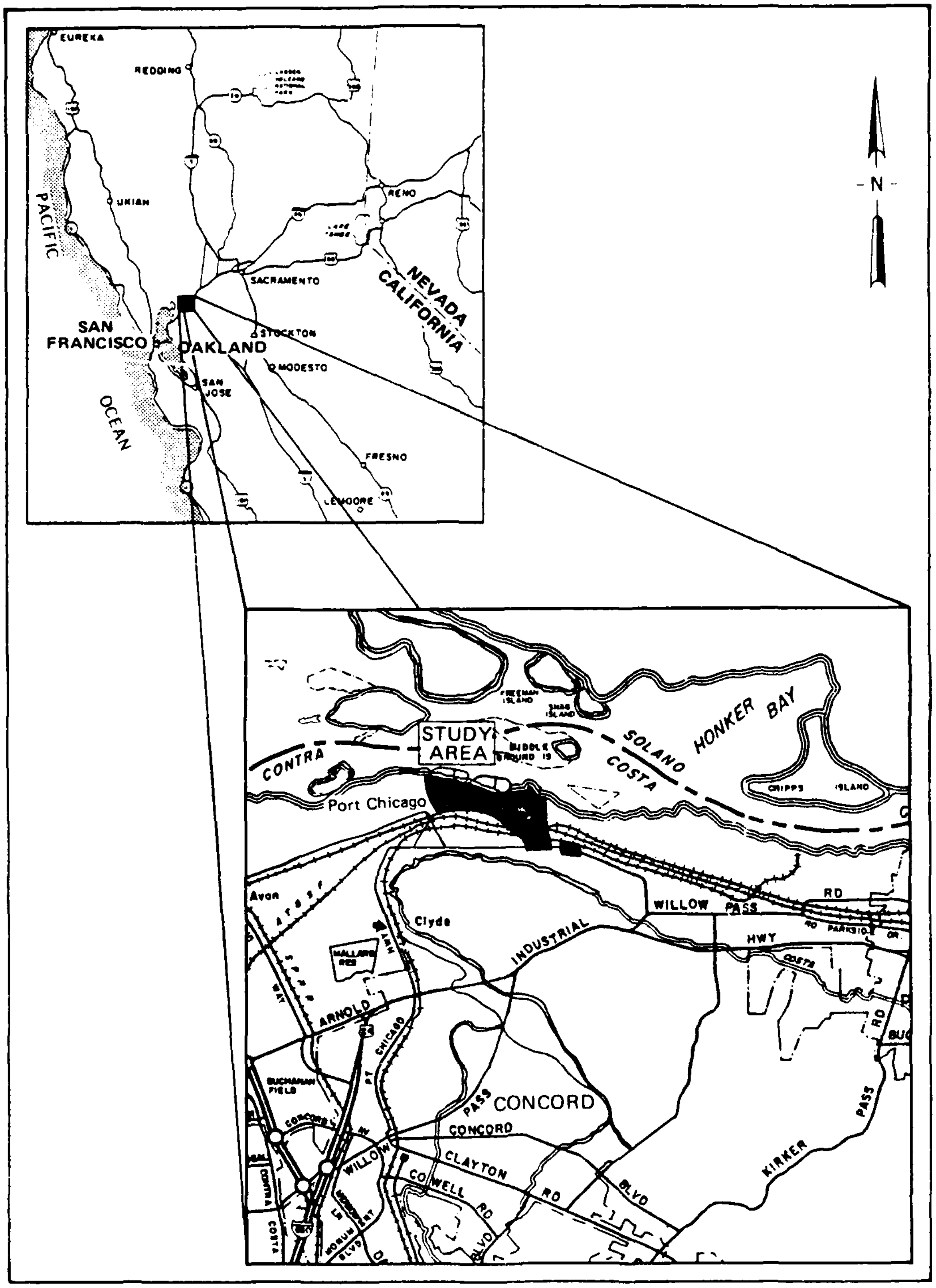

Plate 2.1. Location of NWS Concord study area.

Table 2.1

NWS Concord Acreage Summary

Description	Area (acres)	Total Area (acres)
NWS CONCORD		12,922.15
CONCORD TIDAL AREA		7,648.16
Mainland	6,077.16	
Islands	1,571.00	
CONCORD INLAND AREA		5,272.31
Operations/Support/Storage	5,213.41	
Naval Reserve Training Facility	0.55	
Connecting Roads to Tidal Area	27.70	
Housing Area (Officers and Enlisted)	30.65	
Explosive Quantity-Distance Separation Area	935.76*	
Pittsburg Radiography Facility		1.68

* Not included in total.
Source: Naval Facilities Engineering Command, Western Division, October 1979, NWS Concord Master Plan, and Military Construction Project P-197, Appropriated in Fiscal Year 1982.

The Inland Area, which is separated from the Tidal Area by a range of hills not owned by the Navy, encompasses approximately 6,208 acres. A Navy-owned road and rail line link the two areas. Almost 85 percent of the Inland Area is covered by Explosive Quantity-Distance Separation Arcs generated by a number of storage magazines and production facilities. Three roads cross the Inland Area: State Route 4, Willow Pass Road, and Bailey Road. The Contra Costa Canal also crosses the Inland Area. The largest single land use is ammunition storage, which is accommodated in five magazine groups and two groups of barricaded railroad sidings. Various production facilities, a Weapons Quality Engineering Center (WQEC), and the station's administrative

complex are also located in the Inland Area. In addition, the station maintains restrictive easements on land in the hills to the east.

The radiography facility located approximately six miles east of the Tidal Area at Pittsburg, CA, encompasses 3.34 acres of property. The facility was part of the former United States Army Pacific Ordnance Steel Foundry. NWS Concord has title to 1.68 acres of the property; the remaining 1.24 acres are an easement from the United States Steel Corporation for an access road. The facility is similar to the WQEC X-ray facility located in the Inland Area. The radiographic facility is not considered in this study.

2.1.2 Topography. Station elevations range from slightly below sea level in the Tidal Area to ridges of nearly 800 feet along the northern boundary of the Inland Area. The diversity of land forms is shown on the topographic map presented in Figure 2 (Lee, Cullinane, and O'Neil 1988). Originally, the Tidal Area consisted of three distinct land formations: salt marshes along the shore of the Suisun Bay, upland colluvial slope, and sandstone hills. A large section of the marshland was modified when the original Weapons Station was constructed by adding large amounts of fill material. Almost all existing tidal facilities were built on these fill areas. The former city of Port Chicago was located in an area of higher elevation and gentle slope designated as the colluvial slope. The area to the south of the Contra Costa Canal is characterized by steeply sloping terrain, beginning with a 100-foot elevation and rising to over 600 feet. The hills are composed of soft sandstone that is poorly suited for construction. Included in the acreage for the Tidal Area are five islands (Freeman, Roe, Middle Ground, Ryer, and Snag) located in Suisun Bay directly to the north of the shipping channel and two islands (Seal Islands) above the barge pier. The islands are included in Explosive Quantity-Distance Separation Arcs and were acquired along with the two-mile buffer zone which forms the rest of the Tidal Area. Physically, they are similar to the salt marsh areas discussed above.

The Inland Area is similar in character to the central and higher portions of the Tidal Area. Gently sloping land extends through most of the western half of the Inland Area, while the tidal hills extend south and form the eastern boundary of the NWS Concord.

2.1.3 Climatology. The mean annual precipitation for NWS Concord is 15.4 inches (Lee et al. 1986). As in most of northern California, about 84 percent of the rainfall occurs from November through March. The climate in this area is characterized by westerly winds coming through the wind gap formed by the San Francisco Bay and Carquinez Strait. Particularly dominant during the summer months, these westerly winds are minimal from November through February. Occasionally, the late spring and summer weather is influenced by a high pressure ridge over the interior of California, with resulting high temperatures. The average temperature varies from 45°F in January to 75°F in August. In 1960, a high of 106°F in August and a low of 17°F in January were recorded. During the hard freeze of December 1972, the recorded low was 16°F.

2.1.4 Geology. Plate 2.2 is a geological map of NWS Concord with a cross-sectional depiction of the structure of the major geological formations. The up-thrusted bedrock feature which topographically separates the Inland and Tidal Areas is typical of the geology of Contra Costa County, where northwest trending fault systems such as the major, active Antioch, Concord, and Pleasanton faults divide the county into large up-and-down-thrown blocks of Tertiary-age rock. Over 200 earthquakes have been reported in Contra Costa County since 1934. The up-thrown blocks form the hills and the down-thrown blocks form the valleys. Unconsolidated Pleistocene-age alluvial sediments eroded from the up-thrown blocks partially fill the down-thrown valleys, often accumulating in thicknesses exceeding 500 feet.

2.1.5 Soils. The following discussion is extracted from Lee et al. (1986). The marsh and adjacent uplands at NWS Concord are formed from alluvium of three different ages and modes of deposition. At the mouths of canyons and footslopes are terrace remnants of Pleistocene alluvial fans and flood-plain deposits, consisting of irregularly interstratified sand, gravel, silt and clay (Qoa). The Pleistocene deposits are overlain by Holocene flood-plain deposits (Qa) consisting of irregularly interstratified sand, silt, gravel, and clay. These are overlain at the margin of the Bay by bay mud (Qbm), consisting of unconsolidated silt and clay mixed with organic material. The Pleistocene and Holocene alluvial deposits are up to 500 feet thick and comprise a locally important aquifer with highly variab permeability.

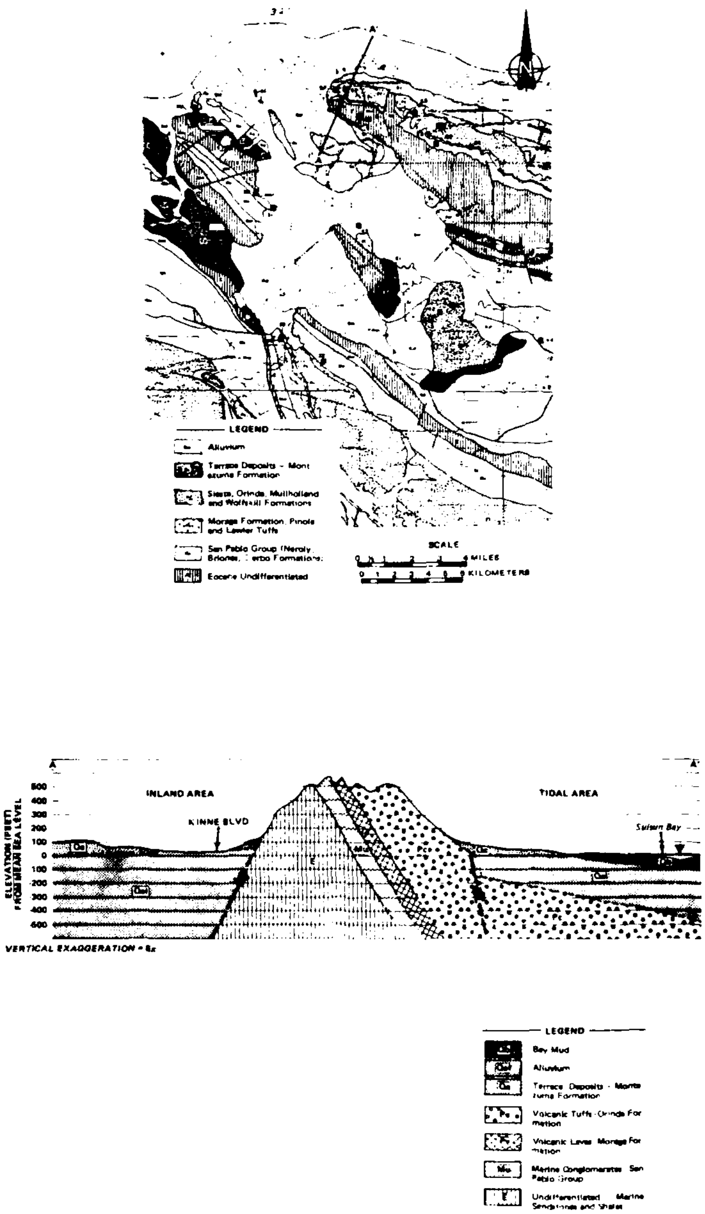

Plate 2.2. Geologic map of NWS Concord.

Most of the alluvium underlying the marsh was deposited when sea level was lower than at present. As the base level rose, the alluvial fans at the mouth of Nichols Creek and nearby tributaries accumulated to higher levels, were reworked, and in places covered with flood-plain deposits by the Sacramento River. As the rate of sea level rise decreased, the present marsh deposits of peat and fine-grained alluvium began to accumulate.

An important feature of the marsh is the tidal drainage pattern, which is oriented parallel to the shoreline at the bay margin. Wave action at the shoreline builds up debris and sediment slightly higher than the elevation of the rest of the marshy plain, reducing direct tidal drainage into Suisun Bay. The relative low density of tributary slough channels is another noteworthy feature of the marsh.

The USDA Soil Conservation Service Soil Survey Report (1978) identifies the soil series found on the site. The marsh soils are identified as Joice Muck series. In the system of the National Cooperative Soil Survey these marsh soils are plastic, euic, thermic Terric Medisaprists. The upland soils (on terrace deposits of alluvium) are classed as Antioch loam (fine, montmorillonitic, thermic Typic Natrixeralfs) or Capay clay (fine, montmorillonitic, thermic Typic Chromoxererts). The soil survey map for the site is shown in Plate 2.3. It appears that the AA and KS areas on Parcel 572 were incorrectly mapped as AdC (Antioch loam), probably because of their light appearance on aerial photographs.

The shoreline at the bayward edge of the marsh is in a dynamic state, having undergone both erosion and recent deposition (Lee et al. 1986). Lumber and other debris of human origin are exposed in the eroding bank at the marsh margin. Wind-generated waves play an important role in both shoreline erosion and during extreme tides, in the erosion of exposed sediment on the marsh plain.

Aside from shoreline erosion and deposition, three other significant long-term hydrologic trends influence the site. First, sea level is rising at a rate of about 0.5 feet per hundred years and is expected to continue rising at an increasing rate due to global climatic changes (USEPA 1983a). The high tides

Plate 2.3. Soil survey map for NWS Concord Tidal Area

of 1983 were among the highest ever recorded, and now form the basis for the estimate of the "100-year high tide" (US Army Corps of Engineers 1984). Second, hydraulic mining in the Sierra Nevada during the last century substantially increased the sediment input to the Bay-Delta system, resulting in extensive shoaling and filling of intertidal areas. Third, grazing in upland areas adjacent to NWS Concord has probably increased the sediment yield of streams discharging into the marsh.

2.1.6 Surface Water Hydrology. Surface water hydrology in the area covered by this study is characterized by both stream and tidal influences. The following discussion of the surface water hydrology is extracted from Lee et al. (1986).

2.1.6.1 The Surface Water System.

The contaminated areas are traversed by a small stream (which will be called Nichols Creek) that originates in the hills south of the study site (Plates 2.4 and 2.5). The watershed area for this creek is slightly over one square mile. North of Port Chicago Highway the stream runs adjacent to the Chemical and Pigment Company plant, under a culvert (Section G-G) under two railroad rights-of-way (the Sacramento Northern Railroad, (SNR) section F-F plate 2.4; and Atchison, Topeka, and Santa Fe (ATSF), section E-E plate 2.4, under one unpaved road (section D-D), and finally under a Southern Pacific Transportation Company (SPTC) railroad trestle and across another ATSF, right-of-way into the salt marsh area (section I-I plate 2.4). A second stream (which will be called the tributary stream) from a watershed west of Nichols Creek joins Nichols Creek just before passing under the railroad trestle into the salt marsh area. This tributary stream receives periodic discharges from the Contra Costa Canal.

Two methods are used for estimating short duration rainfall events and peak discharges for the watersheds draining through the study site. First, raingage data are available at Martinez (about 10 miles west of the site) for short duration events. These can be converted to data for Port Chicago by multiplying by 0.716, the ratio of the one day precipitation at Port Chicago to the one day precipitation at Martinez. These short duration data can be

Plate 2.4. Nichols Creek and tributary including HEC-2 cross-sections

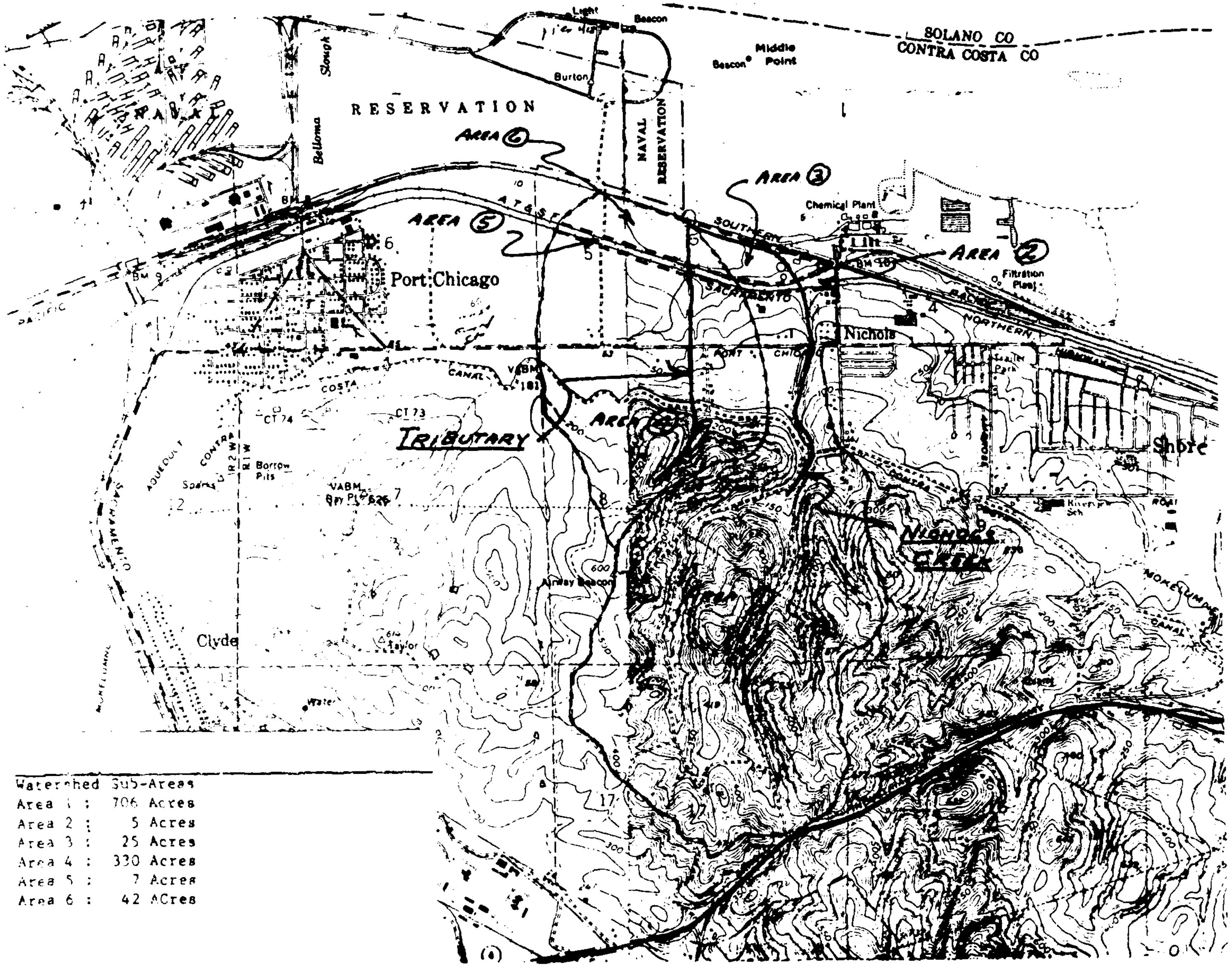

Plate 2.5. Drainage basins of Nichols Creek and tributaries

used to estimate peak discharges using the rational method. A second method for predicting peak discharges is based on streamflow records and is available in Waananen and Crippen (1977). This method uses equations relating flood magnitudes of selected frequency to basin characteristics such as drainage area, precipitation, and altitude for six regions of California.

Both methods have been used to estimate the peak discharge for the watershed areas flowing through the contaminated area. The two methods predict approximately the same peak discharge for recurrence intervals of 50 years, but the method of Waananen and Crippen predicts a lower discharge for recurrence intervals less than 50 years. It is thought that the method of Waananen and Crippen may be more accurate, but calculations made by both methods are presented in Table 2.2.

Between the Port Chicago Highway and the marsh where Nichols Creek terminates, the stream channel is full of a dense stand of cattail (<u>Typha</u> <u>angustifolia</u>). Adjacent to the Chemical and Pigment Company the channel, at times, has supported a luxuriant growth of watercress (<u>Nasturtium</u> sp.).

The stream must pass through culverts under the Port Chicago Highway, under the two railroads, and under the unpaved road. These culverts are susceptible to being blocked with sediment and some may be too small to allow peak discharges of major storms to pass without ponding. Any ponding behind the culverts may represent a control on the actual peak discharges passing down the stream bed to the trestle where it discharges into the marsh.

Water that backs up behind the culverts under the railroad tracks would form an upstream ponding area. Water blocked by the small culvert under the unpaved road north of the ATSF tracks (section D-D, plate 2.4) on Parcel 575 on NWS Concord (G-1 area) would, however, increase in depth until it flowed over the road. From the road much of the overflow could flow in the right overbank area of the stream bed (G-1 area), down the hill and into the ditch (at C, plate 2.4) that runs along the SPTC right of way (north of the G-1 area). This possibility will be discussed in more detail in section 3.1.3.2.

Table 2.2

Discharge in Nichols Creek and Tributary

	Discharge Calculated by Rational Method (Cubic Feet/Second)			Discharge Calculated by Method in Waananen and Crippen (1977) (Cubic Feet/Second)		
Recurrence Interval	Nichols Creek*	Tributary **	Total	Nichols Creek*	Tributary **	Total
2	136	70	206	40	19	59
5	188	97	285	94	47	141
10	225	115	340	145	74	219
20	260	133	393			
25	271	139	410	223	116	339
40	289	149	438			
50	306	158	464	292	154	446
100	335	173	508	369	197	566
200	364	188	552			

* Nichols Creek discharge includes precipitation from watershed areas 1, 2, and 3 of Plate 2.5.

** Tributary discharge includes precipitation from watershed areas 4, 5, and 6 of Plate 2.5.

The present course of Nichols Creek is quite different than its original course. The pre-railroad survey of 1866 (T1029) shows Nichols Creek entering the marsh at approximately the KS area (section A-A, plate 2.4), with a "bulge" in the contours that suggests a small fan in the marsh at the mouth of the creek. When the railroad was built in the late 1860s, a stream crossing was apparently installed. It is unclear how long this structure functioned effectively. Aerial photography, dated 1939 and 1959, shows the creek passing under the SPTC tracks through the culvert (section A-A plate 2.4). It appears from available aerial photos that at some time during the 1960's Nichols Creek was diverted to flow along the south side of the SPTC tracks to the trestle, at which point it joins a tributary stream and flows under the trestle (at section I-I, plate 2.4) into the salt marsh located north of the SPTC tracks. This diversion was accomplished by building up a small berm along the south side of the SPTC tracks, which kept the creek constrained to its new channel

running through the X-2 area to the trestle. A depression, about 50 feet east of the culverts, marks what could be the old channel. The culverts under the SPTC tracks (twin 32-inch corrugated metal pipe) are at present half-filled with sediment, and now receive drainage only from the ditch on the south side of the tracks east of the culverts. Old maps from 1886 (T1793) show cultivated fields north of the SPTC track.

2.1.6.2 The Tidal System.

In addition to storm runoff, tidal action also influences the study area. The following discussion of tidal influences in the study area is extracted from Lee et al. (1986).

Three major manmade alterations to the natural tidal influences have been implemented. The first alteration of tidal drainage occurred sometime after 1888, and probably in the early 20th century. Channels were dredged southward from the shoreline, and the naturally occurring slough channels were connected to these. This probably increased tidal action in the marsh, resulting in higher highs and lower lows of tidal range. The second alteration of the local tidal drainage pattern occurred in or prior to 1959 when the local mosquito abatement district excavated a network of ditches in the marsh to improve drainage. These have been cleared out subsequently, and substantially increased the circulation of tidal water through the marsh. The third alteration of marsh drainage occurred as a result of the overflow from the Allied Chemical waste lagoon in area AA. This flow of waste lagoon sludge over the marsh plain raised the elevation locally, and filled the heads of the natural slough channels.

Table 2.3 shows heights of high and low tides (NGVD datum) at Middle Point (See Table 2.3 for acronyms for tidal levels). These are based on interpolation between tidal stations at Port Chicago and Mallard Island Ferry wharf, about one mile to the east.

To derive the curve for duration of tidal height at Middle Point, it was necessary to use the established curve for Ft. Point (San Francisco) and adjust for local conditions. First, the normalized curve (Harris 1981) was

Table 2.3

Tidal Elevations near NWS Concord

	Port Chicago		Middle Point		Mallard Island	
	MLLW	NGVD	MLLW	NGVD	MLLW	NGVD
MHHW	4.7	3.02	4.40	2.90	4.00	2.80
MHW	4.15	2.47	3.80	2.30	3.45	2.25
MTL	2.4	0.72	2.20	0.70	2.00	0.80
1929 MSL	1.68	0	1.55	0	1.20	0
MLW	0.65	-1.03	0.60	-0.90	0.55	-0.65
MLLW	0	-1.68	0	-1.50	0	-1.20
Mean Range		3.5		3.2		2.9
Mean Diurnal Range		4.7		4.4		4.0
Relation to Ft. Point, San Francisco						
Time (hours)						
high	+2:36		+2:59		+3:26	
low	+3:08		+3:33		+4:03	
Height (feet)						
high	-1.0		-1.3		-1.7	
low	-0.4		-0.45		-0.5	

All elevations given in feet.

MHHW = Mean Higher High Water
MHW = Mean High Water
MTL = Mean Tide Level
MSL = Mean Sea Level
NGVD = National Geodetic Vertical Datum
MLW = Mean Low Water
MLLW = Mean Lower Low Water

multiplied by half the mean diurnal range at the site. This curve is based on predicted astronomical tides. Assuming that the MHW and MHHW are equalled or exceeded at Ft. Point and Middle Point for the same percentage of the time, the curve was then adjusted to fit local MHW and MHHW. Plate 2.5 is the adjusted curve.

A curve for frequency of higher high tides was derived in similar fashion. First, the normalized curve for frequency of higher highs (Harris 1981) was converted from MSL to MLLW datum, for Ft. Point. The values were then multiplied by half the mean diurnal range at Middle Point (2.2 feet) to give the frequency of higher highs at the site, using MLLW datum. These values were then converted to NGVD and plotted as Plate 2.6. It shows the percentage of higher high waters that exceed the indicated elevation.

The duration and frequency of tide heights in the marsh, however, differ from those in the bay. In order to establish the relationship, staff gages and stage level recorders were installed in sloughs and ditches at four locations (Plate 2.7). Gage 1 is at the slough mouth, near Pier 4. Gage 2 is in about the middle of the marsh, 100 feet northwest of survey control point No. 11. Gage 3 is near the upper end of the eastern area of the slough, and Gage 4 is in a mosquito ditch about 450 feet west of the allied dike, in area AA. Gages 1 and 2 were surveyed by differential leveling from bench marks established by Towill, Inc., with one instrument setup each. Gages 3 and 4 were surveyed from a Coast and Geodetic Bench Mark on Allied property. Closure error was 0.03 feet, and this error was distributed. The elevations of several spring higher high tides were then read at each location (Table 2.4). The data indicate that high tides are slightly attenuated (about 0.6 feet) as the tidal wave moves up the slough into the marsh, and that most of the attenuation occurs in the lower half of the slough channel.

A fifth gage was placed at control point No. 11 (elev. 3.10). The tides of June 2nd and 3rd, 1985, recorded elevations of 3.46 and 3.55 just 100 feet away at Gage 2, but the vegetation on the marsh plain, mostly salt grass (Distichlis spicata) at this location, prevented water from flowing over the surface to the control point. The soil, however, was moist on the days following the high tides.

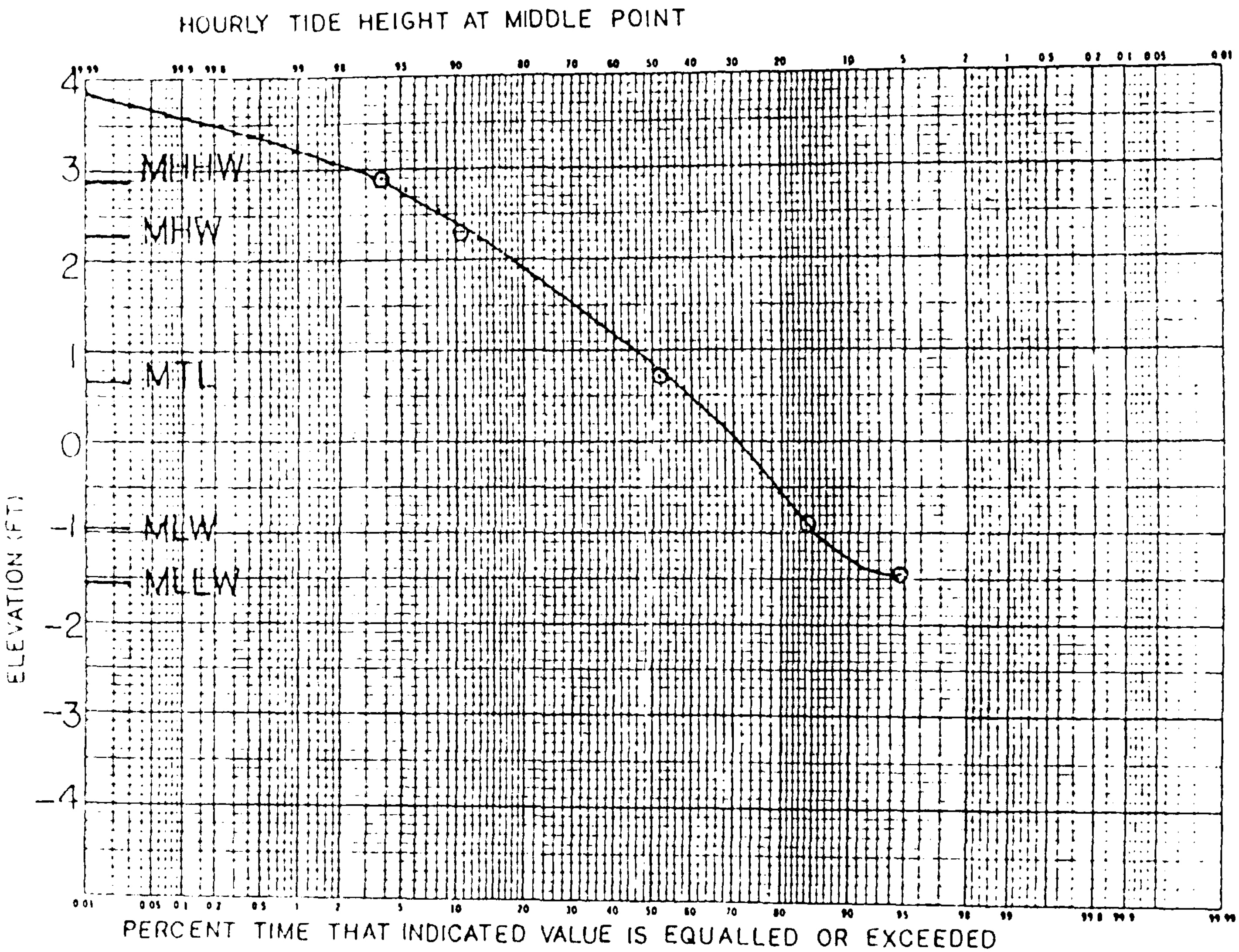

Plate 2.6. Duration of tide height at Middle Point

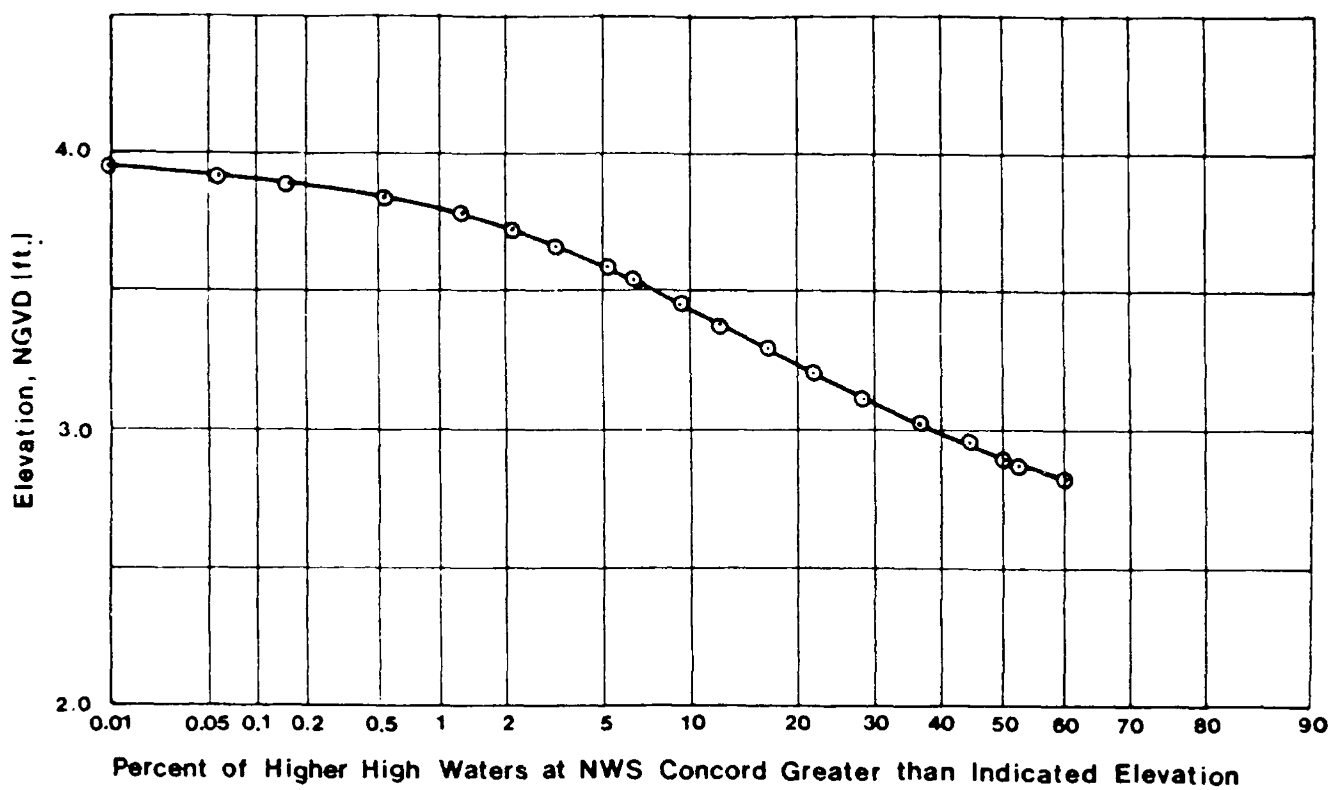

Plate 2.7. Duration of highei high tide at Middle Point

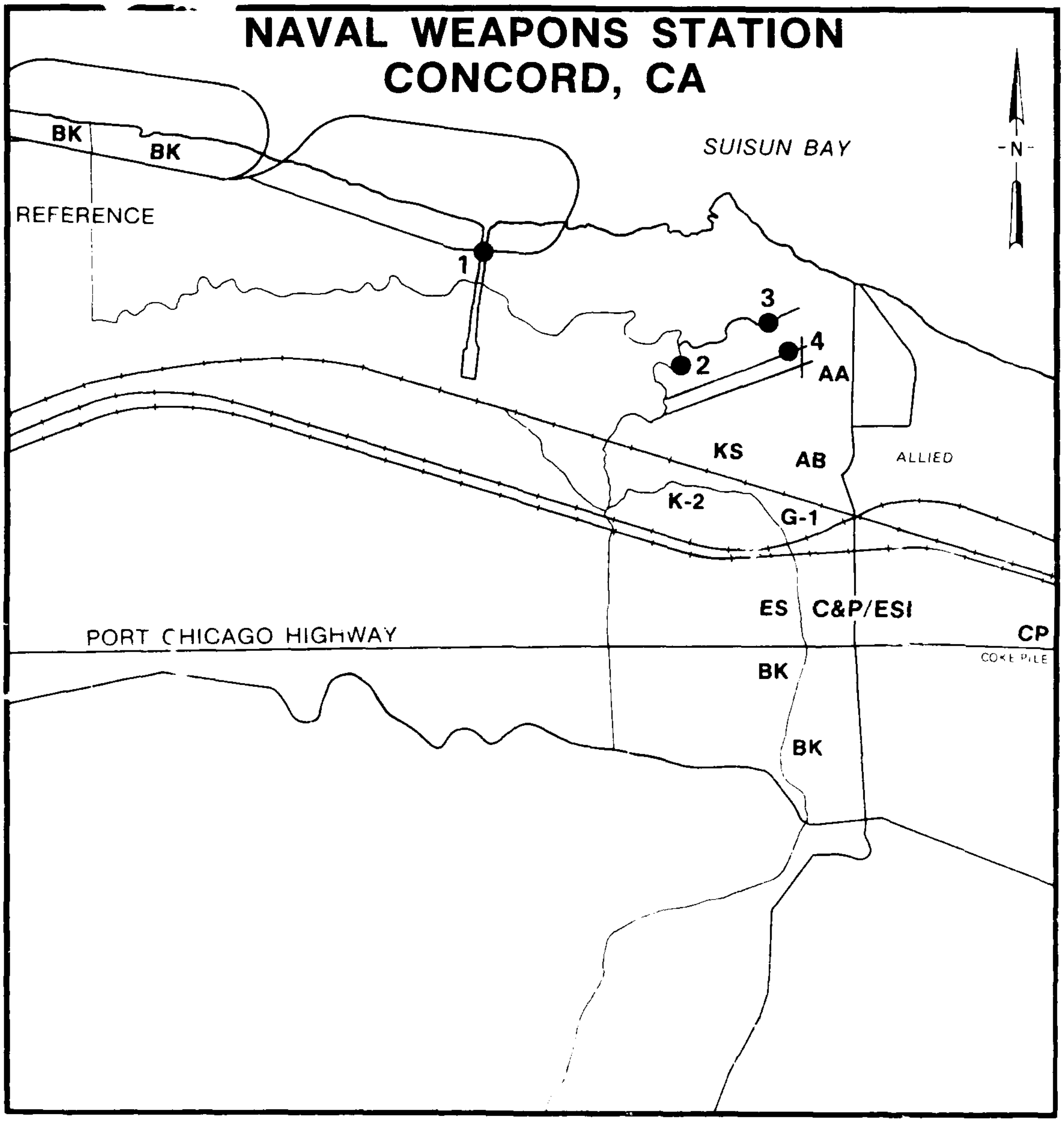

Plate 2.8. Tide staff gage locations on Parcels 571 and 572 at Naval Weapons Station Concord (from Lee et al. 1986)

Table 2.4

Maximum Tide Height at Staff Gages in NWS Concord Marsh

	Gage Number			
Date of High Water	1	2	3	4
*Dec. 1983 (?)	5.92	-	-	-
June 2, 1985	3.81	3.46	3.42	-
June 3, 1985	3.92	3.55	3.54	3.33
June 18, 1985	3.81	3.52	3.50	3.32
July 2, 1985	3.99	3.55	3.50	3.31
Nov. 14, 1985	4.09	-	3.77	3.54
Dec. 12, 1985	3.83	3.55	3.44	3.27
**Feb. 21, 1986	5.03	About 5.1 across marsh		
Dec. 30-31, 1986	4.23	-	3.87	3.67

All elevations in feet NGVD.

* Highest flood mark on bridge near Gage 1; date uncertain.

** Highest flood marks associated with extreme flood; about 1.3 feet above predicted astronomical tide.

Because vegetation has such a retarding effect on tides that just barely flood the marsh plain, it is not feasible to draw an accurate map of tidal inundation frequency using just topographic information. It is possible, however, to infer something about the extent and frequency of tidal flooding for different portions of the marsh. Table 2.5 shows the frequency and duration of tide height for different areas of the marsh. Mean Higher High Water is equalled or exceeded 3 percent of the time, or 176 times per year. Such a tide fills sloughs and ditches in the marsh to within about 0.5 feet of the bank top. The ditches and sloughs are completely filled by a high tide that is equalled or exceeded about 74 times per year, or 15% of the time. High tides of 3.6 - 3.8 feet NGVD at the slough mouth are equalled or exceeded 0.1 to 0.01 percent of the time (16 to 3.5 times per year) and result in maximum water elevations in the upper marsh of 3.1 to 3.2 feet. These tides flood the depressions in the marsh plain near sloughs and ditches, but areas remote from sloughs with dense vegetation are moistened but not inundated.

Table 2.5

Tidal Duration and Frequency for NWS Concord Marsh, Based on Adjusted Curve for Ft. Point and Staff Gage Readings in the Marsh

Tide	Duration (% hours)	Frequency (Higher Highs)	Average Times per Year	Slough Mouth	Mid Slough	Upper Slough
MHHW	3	0.50	176	2.90	2.56	2.33
	1.00	0.21	74	3.20	2.86	2.63
	0.10	0.45	16	3.60	3.26	3.03
	0.01	0.01	3.5	3.80	3.46	3.23
10-year high tide	---	2.8×10^{-4}	0.1	5.70	5.36*	5.13*
100-year high tide	---	2.8×10^{-5}	.01	6.2	5.86*	5.29*

* These elevations are based on the questionable assumption that extreme high tides are attenuated as much as more frequent high tides. The actual extreme high tide elevations probably are not much different from the elevations at the slough mouth.

As a result of the record high tides of 1983, the Army Corps of Engineers undertook a new 100-year high tide study (US Army Corps of Engineers 1984). The 10-year and 100-year high tide elevations from that study are also shown in Table 2.5. They represent a different statistical distribution than the predicted astronomical tides because they reflect actual measurements of storm surges during high tides.

The 10-year and 100-year high tides reach elevations of 5.7 and 6.2 feet NGVD respectively, at the slough mouth. These tides may not be attenuated by slough channels and marsh vegetation as much as somewhat lower tides. Consequently, the 10-year high tide would completely inundate the marsh plain (including area AA on Parcel 572), lapping against the dike and railroad embankments, and covering part of the contaminated KS area on Parcel 572. This tide would reach under the SPTC trestle and inundate the lower portion of the K-2 area on Parcel 573. This was observed to be the case during the February 1986 flood (Coats 1986).

2.1.7 Ground water Hydrology. There are moderate amounts of ground water on NWS Concord, both in the unconsolidated formations and the bedrock. However, satisfactory yields can generally be obtained only by drilling deeper bedrock wells. Until the early 1960s, NWS Concord obtained its water supply from three 500-foot-deep wells. However, at that time, the wells were shut down and NWS Concord, as is the case with nearly all Bay Area communities, now derives its water supply from surface sources.

Ground water quality is generally only fair. Total dissolved solids, hardness, chlorides, and iron concentrations are relatively high, especially when compared to available surface water in the area.

Some wells in the area are still used for water supply. These include several wells in the industrial complex area to the west, used primarily for process water and cooling water, and a series of wells surrounding Mallard Reservoir, to the southwest. The owner of the Mallard Reservoir, the Contra Costa County Water District, uses the ground water to augment the normal aqueduct supplies of drinking water to the reservoir during droughts.

2.1.8 Land Use. Suisun Bay and a conglomerate of islands containing marshlands and numerous man-made levees are located to the north of the Tidal Area. As mentioned previously, Ryer, Roe, Freeman, Snag, Middle Ground and Seal islands are a part of the NWS Concord landholdings. The other islands in this area are privately owned and managed as a wetland system by the Suisun Marsh Conservatory. Recreational activities such as duck hunting and fishing constitute the major land use in this area, although farther to the north, portions of the islands are used for growing specialty crops such as asparagus.

Within the Tidal Area there are privately owned parcels of land that belong to two chemical companies: the Bay Point Works, currently or formerly owned by Allied Corporation, and the plant owned by Chemical and Pigment Company. The Bay Point Works is engaged primarily in the manufacture of aluminum sulfate, sulfuric acid, hydrofluoric acid, nitric acid, and acetic acid. The Chemical and Pigment Company is involved in the manufacture of inorganic chemicals. There have been incidents in the past of contamination of NWS Concord parcels by activities of these chemical companies.

Three railroads, the ATSF, SPTC, and SNR,own rights-of-way that bisect the Tidal Area. The Port Chicago Highway and the Waterfront Road, both county-owned roads, and the Contra Costa Canal complete the list of non-Navy controlled land uses within the NWS Concord Tidal Area.

Land to the east of the Tidal Area is sparsely developed, with only a small residential area named Shore Acres and the McAvoy boat harbor. Oil refineries are located farther to the east, adjacent to Suisun Bay in the City of Pittsburg.

The hills which separate the Tidal and Inland Areas are the site of the Los Medanos underground gas storage field. This land is privately owned and is leased to the Pacific Gas and Electric Company for deep well gas injection. The land is also used for cattle grazing. Located 15 miles to the southeast of the station is the Mt. Diablo State Park and State Game Refuge. This 7,004-acre preserve contains picnic facilities, campsites, and hiking trails.

The station is bordered on the south by the residential sections of the City of Concord. These neighborhoods are made up of single-family, medium-density housing. Most of the housing dates from the mid-1950s. In addition, seven public schools and several parks parallel the Navy property line. Steep slopes and access problems have prevented extensive development along Kirker Pass Road and in the hills northeast of the NWS Concord. These areas are still zoned for open space and agricultural land uses. A recent exception to this is the Concord Pavilion, which was constructed on Kirker Pass Road near the station boundary.

The Concord Municipal Golf Course occupies a triangular parcel of land between State Route 4, the Port Chicago Highway, and the station's administration/support complex. The golf course is located on a 66-acre tract of city land and an 80-acre tract of leased NWS Concord land.

To the north of Route 4 and to the west of NWS Concord, land is available in areas zoned for industrial development. Several firms have located here in the last few years, particularly along the Port Chicago Highway across from the main gate of NWS Concord. Phillips Petroleum Company and Monsanto

Chemical Company have facilities along Solano Way near Waterfront Road. There have been no incidents of contamination of Navy lands by these industries. The City of Concord has a large water treatment plant and reservoir just west of Port Chicago Highway.

Between the Inland and Tidal Areas is a small community known as Clyde, which has a population of 300.

2.2 Definition of Remedial Action Subsites

In developing the remedial action plan for the contaminated portions of Parcels 571, 572, 573, 574, 575, 576, 579D, and 581 on NWS Concord, portions of these parcels and four (4) adjacent rights-of-way were divided into four (4) remedial action subsites (RASS's). This division was based on the types of contamination known to exist on each parcel, topography, historic use, and habitat. RASS 1 contains portions of Parcel 571 and Parcel 572 on NWS Concord. RASS 2 contains a portion of Parcel 572 on NWS Concord and a portion of a right-of-way owned and operated by Atchison, Topeka, and Santa Fe Railway Company and the Southern Pacific Transportation Company. RASS 3 contains portions of Parcels 573, 574, 575, 576, and 579D on NWS Concord and portions of rights-of-way owned and operated by SPTC, ATSF, and SNR. RASS 4 contains Parcel 581 on NWS Concord. Figure 2 (Lee, Cullinane, and O'Neil 1988) shows the general location of RASS 1, RASS 2, RASS 3, and RASS 4.

A detailed description of each RASS and the rationale for aggregating the seven contaminated areas into RASS's is presented below. A summary of the estimated area of each RASS is presented in Table 2.6.

Review of the RI (Lee et al. 1986) and subsequent studies (Lee et al. 1988, O'Neil 1988) revealed that the environment of the seven contaminated areas on the NWS Concord is diverse, including: uplands, brackish and fresh water wetlands, upland-wetland transition zones, intermittent and perennial streams, and tidally influenced areas. The differing topography and hydrology result in significantly different habitats and biological communities. Endangered species, as well as candidates for listing, are found in three of the contaminated areas. Comments received on the Final Draft Feasibility Study

Table 2.6

Summary of Areas in Each RASS

	Wetland Area	Non-Wetland Area	Total Acres in Subareas
RASS 1			
572-N	111.38	1.48	112.86
571-N	11.31	--	11.31
571-SF	0.85	--	0.85
571-SP	0.05	0.36	0.41
CC*	7.41	--	7.41
CCSF*	0.36	--	0.36
CCSP*	0.19	--	0.19
Other-N*	68.38	--	68.38
Other-SF*	4.00	--	4.00
Other-SP*	1.15	1.14	2.29
Stream*	1.72	--	1.72
SUBTOTAL	206.80	2.98	209.78
RASS 2			
572 N	3.97	4.25	8.22
572 SF	1.28	2.01	3.29
572 SP	0.19	1.62	1.81
SUBTOTAL	5.44	7.88	13.32
RASS 3			
573-Other-SP*	0.43	--	0.43
573-Other-N*	3.23	2.44	5.67
573-Other-SF*	0.02	0.98	1.00
573-SP	--	0.82	0.82
573-N	6.25	5.30	11.55
573-SF	--	1.60	1.60
574-SP	--	0.72	0.72
574-N	1.75	9.28	11.03
574-SF	--	0.81	0.81
575-SP	--	1.26	1.26
575-N	0.25	8.53	8.78
575-SF	--	1.37	1.37
576-SF	--	1.73	1.73
576-N	0.01	1.86	1.87
576-SN	--	1.21	1.21
576D-Other-N	--	15.21	15.21
579D-N	0.23	5.46	5.69
579D-SN	--	0.26	0.26
579D-CP-SN	--	0.20	0.20
SUBTOTAL	12.17	59.04	71.21
RASS 4			
581-N	0.68	10.01	10.69
581-Other-N*	2.50	0.10	2.60
SUBTOTAL	3.18	10.11	13.29
TOTAL	227.59	80.01	307.60

* Wetland acres for these subareas were estimated from topography.

(Cullinane et al. 1986) stated that the approach used to evaluate potential remedial action alternatives was not specific enough to allow detailed analysis. Because of the length of time that the contaminated sites have been under study and the numerous contractors performing sampling and analysis functions, boundaries of the seven sites were never well defined and consequently subject to some interpretation. In response to the above, the seven sites were consolidated into four remedial action subsites (RASS's). These subsites include both Navy property and some adjacent properties of responsible parties. It should be noted that the primary emphasis of the RI (Lee et al. 1986) and this feasibility study is contamination on Navy property. Although some sampling and analysis of properties adjacent to Navy property have been conducted, substantial areas of suspected contamination on property adjacent to Navy property have not been investigated. This is particularly true of the Allied Corporation Bay Point Works property to the east and south of Parcel 572.

2.2.1 Remedial Action Subsite 1. RASS 1 is primarily a brackish water, tidally influenced wetland area with minimal upland and associated transition zone. RASS 1 includes portions of parcel 571 and 572 on Navy property and adjacent properties. RASS 1 includes contaminated areas previously identified as AA and AB in the RI (Lee et al. 1986). RASS 1, containing 209.78 acres, is generally bounded on the south by the centerline of the SPTC mainline railroad track, on the east and southeast by the property boundary between Parcel 572 on NWS Concord and the Allied Corporation Bay Point Works extended from the centerline of the SPTC mainline railroad to Suisun Bay, on the north by Suisun Bay, and on the west by the centerline of the unnamed road immediately to the west of the Pier 4 slough extended from the SPTC mainline railroad track to Suisun Bay, less the area contained in RASS 2. The general location of RASS 1 is shown in Figure 2 (Lee, Cullinane, O'Neil 1988). For purposes of analysis, RASS 1 contains 11 subareas as follows. These areas are shown on Figures 3, 4, and 5 (Lee, Cullinane, and O'Neil 1988).

Notation	Description
571-N	Parcel 571 owned by the Navy
571-SF	Property adjacent to Parcel 571 owned by ATSF

(Continued)

Notation	Description
571-SP	Property adjacent to Parcel 571 owned by SPTC
572-N	Parcel 572 owned by the Navy
CC	Property controlled by Contra Costa County
CC-SF	Property adjacent to the Contra Costa County Property owned by ATSF
CC-SP	Property adjacent to the Contra Costa County Property owned by SPTC
Other-N	Property to the west of Parcel 571 owned by the Navy
Other-SP	Property to the west of Parcel 571 owned by SPTC
Other-SF	Property to the west of Parcel 571 owned by ATSF
Stream	Area of stream bed between Parcel 571 and 572

2.2.2 Remedial Action Subsite 2. RASS 2 contains wetland, upland, and transition zones. RASS 2 includes the area formerly designated as the Kiln Site (KS) in the RI (Lee et al. 1986). RASS 2, containing 13.32 acres, is bounded on the south by the centerline of the SPTC railroad track, on the east partially by the property boundary between Navy Parcel 572 on NWS Concord and the Allied Corporation Bay Point Works which runs approximately north and south extended from the centerline of the SPTC railroad to the first mosquito ditch in the wetland, on the north by the first mosquito ditch in the wetland, and on the west by the centerline of Nichols Creek. The general location of RASS 2 is shown in Figure 2 (Lee, Cullinane, and O'Neil 1988). For purposes of analysis, RASS 2 contains three subareas described as follows. These areas are shown on Figure 3 (Lee, Cullinane, and O'Neil 1988).

Notation	Description
572-N	Parcel 572 owned by the Navy
572-SF	Property adjacent to Parcel 572 owned by ATSF
572-SP	Property adjacent to Parcel 572 owned by SPTC

2.2.3 Remedial Action Subsite 3. RASS 3 includes freshwater wetlands, uplands, and associated transition zones. RASS 3 is primarily characterized as a riparian drainageway consisting of Nichols Creek and an unnamed tributary that flow through the subsite. RASS 3 includes areas formerly designated as ES, G1, and K2 on Parcels 573, 574, 575, 576, and 579D on NWS Concord as

described in the RI (Lee et al. 1986). RASS 3, containing 71.21 acres, is generally bounded on the north by the centerline of the SPTC railroad; on the south by either the centerline of the ATSF railroad, Port Chicago Highway, or the Chemical and Pigment Company property boundary; on the east by the Chemical and Pigment Company property boundary; and on the west by a line running north and south between the SPTC and ATSF railroads, 400 feet west and parallel to the western boundary of Parcel 573 and a southerly extension of the eastern boundary of Parcel 579D to Port Chicago Highway. The general location of RASS 3 is shown on Figure 2 (Lee, Cullinane, and O'Neil 1988). For purposes of analysis, RASS 3 contains nineteen subareas described as follows and shown in Figure 6 (Lee, Cullinane, and O'Neil 1988).

Notation	Description
573-N	Parcel 573 owned by the Navy
573-SP	Property adjacent to Parcel 573 owned by SPTC
573-SF	Property adjacent to Parcel 573 owned by ATSF
573-Other-N	Property to the west of Parcel 573 owned by the Navy
573-Other-SP	Property to the west of Parcel 573 owned by SPTC
573-Other-SF	Property to the west and south of Parcel 573 owned by ATSF
574-N	Parcel 574 owned by the Navy
574-SP	Property adjacent to Parcel 574 owned by SPTC
574-SF	Property adjacent to Parcel 574 owned by ATSF
575-N	Parcel 575 owned by the Navy
575-SP	Property adjacent to Parcel 575 owned by SPTC
575-SF	Property adjacent to Parcel 575 owned by ATSF
576-N	Parcel 576 owned by the Navy
576-SN	Property adjacent to Parcel 576 owned by SNR
576-SF	Property adjacent to Parcel 576 owned by ATSF
579D-N	Parcel 579D owned by the Navy
579D-SN	Property adjacent to Parcel 579D owned by SNR
579D-CP-SN	Property adjacent to Parcel 579D and Chemical and Pigment property owned by SNR
579D-Other-N	Property to the west of Parcel 579D owned by the Navy

2.2.4 Remedial Action Subsite 4. RASS 4 is primarily an upland area; however, RASS 4 includes portions of a freshwater wetland and associated transition zone on its eastern boundary. RASS 4 includes the CP area on Parcel 581

on NWS Concord as designated in the RI (Lee et al. 1986). The general location of PASS 4 is shown on Figure 2 (Lee, Cullinane, and O'Neil 1988). RASS 4, containing 13.29 acres, is bounded on the north, south, and west by the boundary of Parcel 581. On the east, RASS 4 is bounded by a line parallel to and 400 feet east of the eastern boundary of Parcel 581. For purposes of analysis, RASS 4 contains two subareas described as follows as shown in Figure 7 (Lee, Cullinane, and O'Neil 1988b).

Notation	Description
581-N	Parcel 581 owned by the Navy
581-Other-N	Property adjacent to Parcel 581 owned by the Navy

2.3 Nature and Extent of Problems

Previous studies (Ecology and Environment 1983, Anderson Geotechnical 1984, Lee et al. 1986, and Lee et al. 1988) have identified seven areas located on eight parcels (Parcels 571, 572, 573, 574, 575, 576, 579D, and 581) on NWS Concord where contamination has occurred. Contamination on adjacent non-Navy property has also been identified. As discussed above, these areas of contamination were aggregated into four separate remedial action subsites for further evaluation. These subsites contain approximately 308 acres and include both wetland and upland portions of the tidal plain adjacent to Suisun Bay. The location and general boundaries of each area where hazardous substances have been released are presented in Plate 1.1 and Figure 2 (Lee, Cullinane, and O'Neil 1988). A complete description of the nature and extent of contamination at the NWS Concord site is presented in Ecology and Environment (1983), Anderson Geotechnical (1984), Lee et al. (1985), Lee et al. (1986), Lee et al. (1988), and US Navy (1987). A summary of contamination levels found on each RASS is presented in Table 2.7. A brief history of each parcel and area and the activities associated with each is presented below. A more detailed analysis of contamination is presented in Section 3.

2.3.1 Remedial Action Subsite 1.

RASS 1 includes areas formerly designated as AA and AB.

2.3.1.1 Allied Site A.

Allied Site A (AA) is located in a tidal marsh on Parcel 572 on NWS Concord. The United States acquired Parcel 572, on behalf

Table 2.7

Summary of Contamination on RASS's 1, 2, 3, and 4 and Reference Area

Variable	SOIL N	SOIL Minimum Value	SOIL Maximum Value	PLANTS N	PLANTS Minimum Value	PLANTS Maximum Value	EARTHWORMS N	EARTHWORMS Minimum Value	EARTHWORMS Maximum Value	CLAMS N	CLAMS Minimum Value	CLAMS Maximum Value
RASS 1												
AS	109	3.0	2484.8	54	0.0	26.7	63	2.2	150.6	28	1.1	2.4
CD	109	0.0	75.4	54	0.0	2.1	63	0.2	13.7	28	0.0	2.7
CU	109	25.3	1268.1	54	1.5	16.5	63	6.1	159.2	28	43.5	87.9
PB	109	0.0	428.8	54	0.0	4.5	63	0.0	19.9	28	0.0	1.0
ZN	109	50.1	3998.1	54	7.4	159.7	63	102.0	400.9	28	100.8	167.5
NI	109	10.7	104.3	54	0.0	7.9	63	0.0	14.3	28	0.0	4.5
SE	67	0.0	11.8	54	0.0	1.0	63	1.4	8.4	28	0.8	1.5
pH	109	3.8	7.4									
RASS 2												
AS	8	5.1	103.1	5	0.0	0.0	5	4.3	25.6	--	--	--
CD	8	8.9	88.5	5	4.8	41.7	5	9.0	53.7	--	--	--
CU	8	96.4	1498.5	5	0.0	13.2	5	22.9	187.7	--	--	--
PB	8	48.7	4675.2	5	0.4	24.3	5	2.3	23.6	--	--	--
ZN	8	740.7	50276.9	5	137.1	555.9	5	152.7	433.2	--	--	--
NI	8	38.8	75.0	5	1.4	10.6	5	2.9	5.8	--	--	--
SE	5	0.1	4.3	5	0.0	0.0	5	1.2	15.4	--	--	--
pH	8	5.2	8.2									
RASS 3												
AS	83	0.8	303.0	53	0.0	0.4	54	1.4	19.9	30	0.9	2.4
CD	83	0.2	45.2	53	0.0	26.6	54	2.2	21.9	30	0.2	1.5
CU	83	7.0	3053.3	53	1.7	20.1	54	7.4	103.5	30	44.1	83.1
PB	83	0.4	7599.7	53	0.0	10.5	54	0.0	224.6	30	0.0	9.2
ZN	83	34.5	85494.2	53	20.1	788.6	54	110.4	631.9	30	113.3	284.0
NI	83	6.4	257.6	53	0.0	9.8	54	0.8	7.1	30	0.0	10.1
SE	54	0.0	1.3	53	0.0	0.0	54	2.2	20.2	30	0.7	2.1
pH	83	4.3	8.3									

(Continued)

N = Number of Samples.
All values except N and pH are in mg/kg or parts per million (dry weight basis).
AS-Arsenic, CD-Cadmium, CU-Copper, PB-Lead, ZN-Zinc, NI-Nickle, SE-Selenium.

Table 2.7 (Concluded)

Variable	SOIL N	SOIL Minimum Value	SOIL Maximum Value	PLANTS N	PLANTS Minimum Value	PLANTS Maximum Value	EARTHWORMS N	EARTHWORMS Minimum Value	EARTHWORMS Maximum Value	CLAMS N	CLAMS Minimum Value	CLAMS Maximum Value
RASS 4												
AS	37	2.0	89.8	11	0.0	1.6	14	1.7	14.7	--	--	--
CD	37	0.1	29.1	11	4.0	24.9	14	0.8	29.4	--	--	--
CU	37	8.6	253.8	11	5.8	13.1	14	1.4	91.3	--	--	--
PB	37	0.5	4054.7	11	0.0	65.4	14	0.0	76.7	--	--	--
ZN	37	25.0	427.2	11	29.4	118.8	14	111.8	336.3	--	--	--
NI	37	2.9	97.5	11	0.8	17.7	14	1.1	12.0	--	--	--
SE	37	0.0	138.4	11	0.0	11.7	14	3.3	91.3	--	--	--
pH	37	2.9	7.0									
Reference Area												
AS	32	0.1	6.7	29	0.0	0.7	30	0.9	9.9	18	1.5	2.6
CD	32	0.0	3.5	29	0.0	2.0	30	1.6	11.8	18	0.6	0.9
CU	32	5.5	72.8	29	1.0	9.0	30	7.1	14.7	18	39.9	86.0
PB	32	0.0	74.7	29	0.0	1.1	29	0.0	5.8	18	0.0	1.2
ZN	32	25.0	471.6	29	19.4	206.6	30	99.5	162.4	18	99.9	140.0
NI	32	9.7	86.8	29	0.0	4.3	30	0.2	10.3	18	0.0	2.1
SE	30	0.0	27.3	29	0.0	0.0	30	2.1	15.8	18	0.9	2.3
pH	32	4.7	8.2									

of the Navy, from Allied Chemical Corporation on 13 November 1969 by declaration of taking. Elevated concentrations of arsenic, cadmium, copper, and zinc have been detected in the soil at this site. Soil pH values as low as 4.6 have also been detected.

2.3.1.2 Allied Site B. Allied Site B (AB) is also located in a tidal marsh on Parcel 572 on NWS Concord. The United States acquired Parcel 572, on behalf of the Navy, from Allied Chemical Corporation on 13 November 1969 by declaration of taking. Allied Site B is located adjacent to and south of the AA area. Elevated concentrations of arsenic, cadmium, copper, lead and zinc have been detected in this area.

2.3.2 Remedial Action Subsite 2. RASS 2 includes an area previously identified as the Kiln Site (KS). RASS 2 encompasses contaminated areas on Parcel 572 on NWS Concord and rights-of-way owned and operated by the ATSF and the SPTC. The United States acquired Parcel 572, on behalf of the Navy, from Allied Chemical Corporation on 13 November 1969 by declaration of taking. Ten large industrial kilns, known as Herschoff ovens or furnaces, were placed on the right-of-way owned and operated by ATSF in or about 1963. The kilns were demolished in or about 1974, and the debris from the demolition was spread over the ATSF right-of-way and Parcel 572 on NWS Concord. Some removal of soil and debris was undertaken in September 1982; however, elevated of arsenic, cadmium, zinc, copper, and lead have been detected in this area. The majority of the contamination is believed to be in the upper 12 inches of soil, although, some data indicate contamination to depths greater than 36 inches in a smaller area.

2.3.3 Remedial Action Subsite 3. RASS 3 includes contaminated areas previously identified as K-2, G-1, and ES.

2.3.3.1 Parcel 573 (K-2). The United States purchased Parcel 573 on NWS Concord, on behalf of the Navy, from the Santa Fe Railroad Foundation, Inc., on 7 November 1969. Portions of the contaminated K-2 area are located on this parcel. Elevated concentrations of cadmium, copper, lead, and zinc have been detected on this area. A small stream flows through this area

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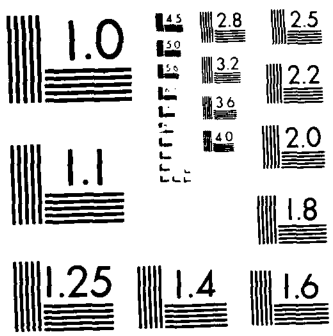
1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
4.5
5.0
5.6

before discharging into the tidal marsh. Contaminated areas adjacent to Parcel 573 have also been identified.

2.3.3.2 Parcel 574 (K-2). The United States acquired Parcel 574 on NWS Concord, on behalf of the Navy, from Elaine A. Nelson on 28 December 1968 by declaration of taking. Portions of the contaminated K-2 area are located on Parcel 574. Elevated concentrations of cadmium, copper, lead, and zinc have been detected in this area.

2.3.3.3 Parcel 575 (G-1). The United States purchased Parcel 575 on NWS Concord, on behalf of the Navy, from Getty Oil Company on 26 January 1971. The contaminated G-1 area is located on Parcel 575. A small stream flows through the G-1 area before entering the K-2 area (Parcels 574 and 573 on NWS Concord) and finally passing under the SPTC railroad tracks and emptying into the tidal marsh. Getty Oil Company owned and operated a pumping station known as Nichols Pump Station on Parcel 575 before the United States purchased the property on behalf of the Navy. Elevated concentrations of copper, zinc, cadmium, and lead have been found in this area.

2.3.3.4 Parcel 576 (ES). The United States acquired Parcel 576 on NWS Concord, on behalf of the Navy, from Marcus H. Gower, Douglas N. Griffen, and Sylvia N. Griffen on 21 June 1971 by declaration of taking. High soil concentrations of lead, copper, zinc, and cadmium have been detected in this area.

2.3.3.5 Parcel 579D (ES). The United States acquired Parcel 579D on NWS Concord, on behalf of the Navy, from Fred H. Hewins, Marguerite Tomas, Bluette Basset, Robert Butzberger, Paulette Hembi, Karl Grauwiler, Rudolph Alexander Grauwiler, and Marianne Grauwiler Konig on 24 November 1975 by declaration of taking. A portion of the contaminated ES area is located on Parcel 579D. Elevated concentrations of lead and zinc have been detected in this area.

2.3.4 Remedial Action Subsite 4. RASS 4 includes Parcel 581 and an adjacent area and was formerly identified as CP. The United States acquired Parcel 581 on NWS Concord, on behalf of the Navy, from Joe Sobotka and Wilda D. Sobotka

on 23 December 1968 by declaration of taking. The contaminated CP area, also known as the Coke Pile, is located on Parcel 581. Elevated concentrations of arsenic, cadmium, lead, copper, zinc, and selenium and low pH values have been found in this area.

2.3.5 Sources on Adjacent Properties. Six adjacent properties contain sources of potential contamination to NWS Concord (US Navy 1987). These are discussed below.

2.3.5.1 Allied Corporation Bay Point Works. The Allied Corporation owns and operates, or until recently owned and operated, the Bay Point Works located immediately east of Parcel 572 on NWS Concord. Evidence obtained in discovery in pending litigation indicates that eight potential sources of contamination are located on this property (Drawing 39) and are briefly discussed below (US Navy 1987).

Old Alum Pond. Evidence obtained in discovery indicates that an area located on the Bay Point Works, known as the Old Alum Pond, was used, until 1973, for disposal of alum mud generated in the process of manufacturing aluminum sulfate.

Lined Alum Ponds. Evidence obtained in discovery indicates that in 1973 the lined alum ponds were installed on the Bay Point Works for the storage of alum mud generated in the process of manufacturing aluminum sulfate. The lined alum ponds are still used for the discharge of alum mud.

Iron Pyrite Cinder and Coke Disposal Area. Evidence obtained in discovery indicates that a large area east of the old alum pond and west of the treatment lagoon on the Bay Point Works was used for the disposal of iron pyrite cinders generated in the process of manufacturing sulfuric acid from iron pyrite ore, and for the disposal of coke used in the same process. The iron pyrite cinders and the coke were buried to depths of 10 feet.

Wastewater Treatment Lagoon. Evidence obtained in discovery indicates that a wastewater treatment and recirculation lagoon is located east of the iron pyrite cinder disposal area on the Bay Point Works. Concentrations of

fluorides, cadmium, aluminum, zinc, lead, arsenic, formaldehyde, and settleable matter are regulated by NPDES Permit (RWQCB 1984). The pH, temperature, and toxicity of the discharge are also regulated. In addition, the impacts of the discharge on the pH, dissolved oxygen, and ammonia of the receiving water are also regulated.

Iron Pyrite Ore Storage Area. Evidence obtained in discovery indicates that an iron pyrite ore storage area was located near the sulfuric acid manufacturing process.

Gypsum Disposal Area. Evidence obtained in discovery indicates that a large gypsum disposal area is located along the northeast portion of the Bay Point Works property.

Lead Arsenate Disposal Area. Evidence obtained in discovery indicates that lead arsenate was disposed along the western edge of the current property boundary between NWS Concord and the Bay Point Works.

Lead Arsenate Disposal Area (Burial). Evidence obtained in discovery indicates that a small lead arsenate burial area is located along the eastern edge of the Bay Point Works.

2.3.5.2 Chemical and Pigment Company. Evidence obtained in discovery in pending litigation indicates that two potential sources of contamination are located on Chemical and Pigment Company property adjacent to and east of Parcel 579D on NWS Concord.

Wastewater Treatment/Recirculation Lagoon. Evidence obtained in discovery indicates that a wastewater treatment and recirculation lagoon is located adjacent to the property boundary between NWS Concord and Chemical and Pigment Company. This lagoon contains high concentrations of copper and zinc.

Waste Disposal Area. Evidence obtained in discovery indicates that a waste burial area is located between the Chemical and Pigment manufacturing facilities and Port Chicago Highway, and adjacent to Parcel 579D on NWS Concord. This burial site contains high concentrations of zinc.

2.3.5.3 Railroad Rights-of-Way. Four rights-of-way (owned and operated by ATSF, SPTC, and SNR) transect Parcels 571, 572, 573, 574, 575, 576, 579D, and 581 on NWS Concord. High soil concentrations of metals have been found in these rights-of-way.

2.4 Previous Response Actions

2.4.1 Response Actions Conducted by Navy. By Executive Order 12,316, the President delegated authority to respond to the release, or the threat of release, of hazardous substances on Department of Defense property under Section 104 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) to the Department of Defense. On 2 November 1981, the Secretary of Defense in turn delegated such authority to respond to the release or threatened release of hazardous substances to the Secretary of the Navy.

By Executive Order 12,580, the President delegated authority to respond to the release, or the threat of release, of hazardous substances on Department of Defense property under Section 104 of CERCLA, as amended by the Superfund Amendments and Reauthorization Act, to the Department of Defense. The Secretary of Defense in turn delegated such authority to respond to the release or threatened release of hazardous substances to the Secretary of the Navy.

Until 1987, the Navy responded to the release or the threat of release of hazardous substances on its property through its Navy Assessment and Control of Installation Pollutants (NACIP) Program. Since 1987, responses to the release of hazardous substances have been conducted through the Installation Restoration (IR) Program. The purpose of both programs has been to identify, assess, and control the contamination of Navy property by hazardous substances.

Under the NACIP and IR Programs, the Navy has responded to the release or the threat of release of hazardous substances in a phased approach. In the first phase of the NACIP program, which the Navy called Initial Assessment, all evidence which indicated that hazardous substances may have been released or may

threaten to be released on Navy property was collected and evaluated. Upon completion of its Initial Assessment Study (Ecology and Environment 1983) of the potentially contaminated sites at NWS Concord in October 1983, the Navy concluded that portions of Parcels 571, 572, 573, 574, 575, 576, 579D, and 581 on NWS Concord had been contaminated with hazardous substances including arsenic, lead, copper, cadmium, iron, zinc, and selenium.

During the second phase (Confirmation Phase) of the NACIP Program, field studies were conducted to confirm or deny the release or the threat of release of hazardous substances on Navy property and to define the extent of harm or threat of harm to the environment and damage or threat of damage to the natural resources on Navy property. As part of this phase, the Navy had soil and water sampling and analyses conducted on Parcels 571, 572, 573, 574, 575, 576, 579D and 581 on NWS Concord in 1983 and 1984 to confirm or deny hazardous substance contamination on those parcels (Anderson Geotechnical 1984). The results of those sampling activities indicated that significant releases of hazardous substances had occurred and demonstrated the need to conduct additional, and more detailed, investigations.

Also during the 1981-1982 time frame, the State of California notified the Navy that portions of the eight parcels were contaminated with hazardous substances.

In 1982 and 1983, the Navy implemented a partial cleanup of Parcels 572 and 581. A licensed contractor was retained to excavate and transport for appropriate disposal 800 cubic yards of material from RASS 2 (area KS on Parcel 572) (IT Corporation 1982) and 3510 cubic yards from RASS 4 (area CP on Parcel 581) (IT Corporation 1983).

In June 1984, the Navy contracted with the Department of the Army, Corps of Engineers, Waterways Experiment Station (WES), to continue the Confirmation Study in six (6) of the nine (9) areas on which the Navy had begun a Confirmation Study in 1983. These areas included the AA, AB, G-1, K-2, KS, and CP areas on Parcels 571, 572, 573, 574, 575, and 581 on NWS Concord.

The objectives of the study conducted by the WES were:

a. To define the nature and extent of the hazardous substance contamination on the property.

b. To assess the bioavailability, mobility, and toxicity of the hazardous substances to plant and animal species on the property.

c. To identify the sources of the hazardous substances detected on the property.

d. To evaluate the extent of the migration of the hazardous substances on the property.

e. To evaluate the condition of the wetland and upland habitats on the property.

In the course of its Confirmation Study on these areas, the Navy issued a Final Draft Report of the Remedial Investigation of Contaminant Mobility (Lee et al. 1985) for the six (6) areas on these parcels in August 1985. In conducting its remedial investigation on these six (6) areas, the Navy discovered an additional area on Parcels 576 and 579D on NWS Concord. In February 1986, the Navy issued a Final Report of the Remedial Investigation of Contaminant Mobility for the seven (7) areas on Parcels 572, 573, 574, 575, 576, 579D, and 581 on NWS Concord. In March 1986, the Navy issued a (Revised) Final Draft Report of the Feasibility Study of Contamination Remediation on the seven (7) areas on the seven (7) parcels on the NWS Concord. In 1986-1987, the Navy conducted additional investigation of contaminant mobility (Lee et al. 1988).

The WES studies (Lee et al. 1985, Lee et al. 1986, and Lee et al. 1988) identified areas of significant contamination and recommended that implementation of remedial actions is appropriate for one or more of the contaminated areas.

As a result of the conclusions of Lee et al. (1985, 1986, and 1988), the Navy retained WES to prepare a Feasibility Study to evaluate potential remedial action alternatives for each of the identified contaminated areas. In August

1985, the Navy issued a Final Draft Report of the Feasibility Study of Contamination Remediation (Cullinane et al. 1986) for the AA, AB, G-1, K-2, KS, and Coke Pile sites on Parcels 572, 573, 574, 575, and 581 on NWS Concord. In March 1986, the Navy issued a (Revised) Final Draft Report of the Feasibility Study of Contamination Remediation for the AA, AB, G-1, K-2, KS, Coke Pile, and ES sites on Parcels 572, 573, 574, 575, 576, 579D, and 581 on NWS Concord.

To address concerns in April and May 1987 raised by the State of California Regional Water Quality Control Board (RWQCB) about the Navy's response on the seven (7) areas on Parcels 572, 573, 574, 575, 576, 579D, and 581 on the NWS Concord, the Navy developed conceptual plans for additional investigations of potential surface water and ground water contamination on these parcels (US Navy 1987). On 5 October 1987, the Navy solicited comments concerning these conceptual plans from the Regional Board by 5 November 1987. This submittal contained an extensive assessment of the contamination present in the soils, biota, and surface water. Included in this submittal were forty-eight (48) figures delineating the horizontal and vertical migration of contamination in these environmental media.

During the period September through October 1987, the Navy initiated planning for the conduct of the additional studies on the areas requested by the RWQCB. These investigations are continuing.

2.4.2 Response Actions Conducted By Other Parties. Response actions, or actions similar to response actions, have been conducted by other parties in Parcel 572 on NWS Concord. In 1976, a partial site remediation was attempted in the AA area adjacent to the Bay Point Works alum pond levee. Agricultural lime was applied to the AA area on Parcel 572 on NWS Concord. No followup monitoring has been documented.

In 1977, Allied Corporation conducted a ground water investigation on the Bay Point Works located adjacent and to the east of RASS 1 and RASS 2. This investigation included sampling and analysis of seven drill holes and 24 driven well points.

In 1983, Kleinfelder and Associates installed and sampled three monitoring wells for Chemical and Pigment Company (Kleinfelder and Associates 1983).

3.0 CONTAMINATION ASSESSMENT AND IDENTIFICATION OF POTENTIALLY APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

The release of hazardous substances on RASS 1, RASS 2, RASS 3, and RASS 4 on NWS Concord is documented in Lee et al. (1986). Additional information on the areas of contamination is provided in Lee et al. (1988) and US Navy (1987).

3.1 Exposure Mechanisms and Contaminant Migration Pathways

A generalized scheme of potential exposure mechanisms and pathways for contaminant mobility at NWS Concord is illustrated in Plate 3.1. The major source of contamination at NWS Concord is hazardous substances that have been deposited on and/or mixed with surface soils. These hazardous substances are cadmium, lead, copper, selenium, zinc, and arsenic. Potential exposure mechanisms and migration pathways for these contaminants include: direct contact with contaminated soils by humans, animals, or plants; bioaccumulation by plants and animals; contact with surface waters; ground water; and air. Lee et al. (1985, 1986, and 1988) and US Navy (1987) evaluated existing and potential contaminant exposure by each of these mechanisms and pathways. The major findings of these evaluations are presented below.

3.1.1 Direct Exposure to Soils.

3.1.1.1 Assessment of Current Soil Contamination. Extensive data have been collected that delineate the horizontal distribution of potentially hazardous metals in the soils of RASS 1, RASS 2, RASS 3, and RASS 4. Data collected prior to September 1984 were summarized in the Draft Confirmation Study Report (Anderson Geotechnical Consultants 1984). This report presented data on the concentrations of ten (10) metals (arsenic, barium, cadmium, chromium, copper, lead, selenium, tellurium, vanadium, and zinc) (Anderson Geotechnical Consultants 1984, Table 2-2), for 368 samples collected at 285 locations in seven (7) areas (including sites within RASS 1, RASS 2, RASS 3, and RASS 4). Both Total Threshold Limit Concentration (TTLC) and Soluble Threshold Limit Concentration (STLC) analyses were included in these data. The draft report defined four (4) areas as contaminated with heavy metals, including Allied A (now part of RASS 1), the Kiln Site (now RASS 2), and K-2 and G-1 (now part of RASS 3).

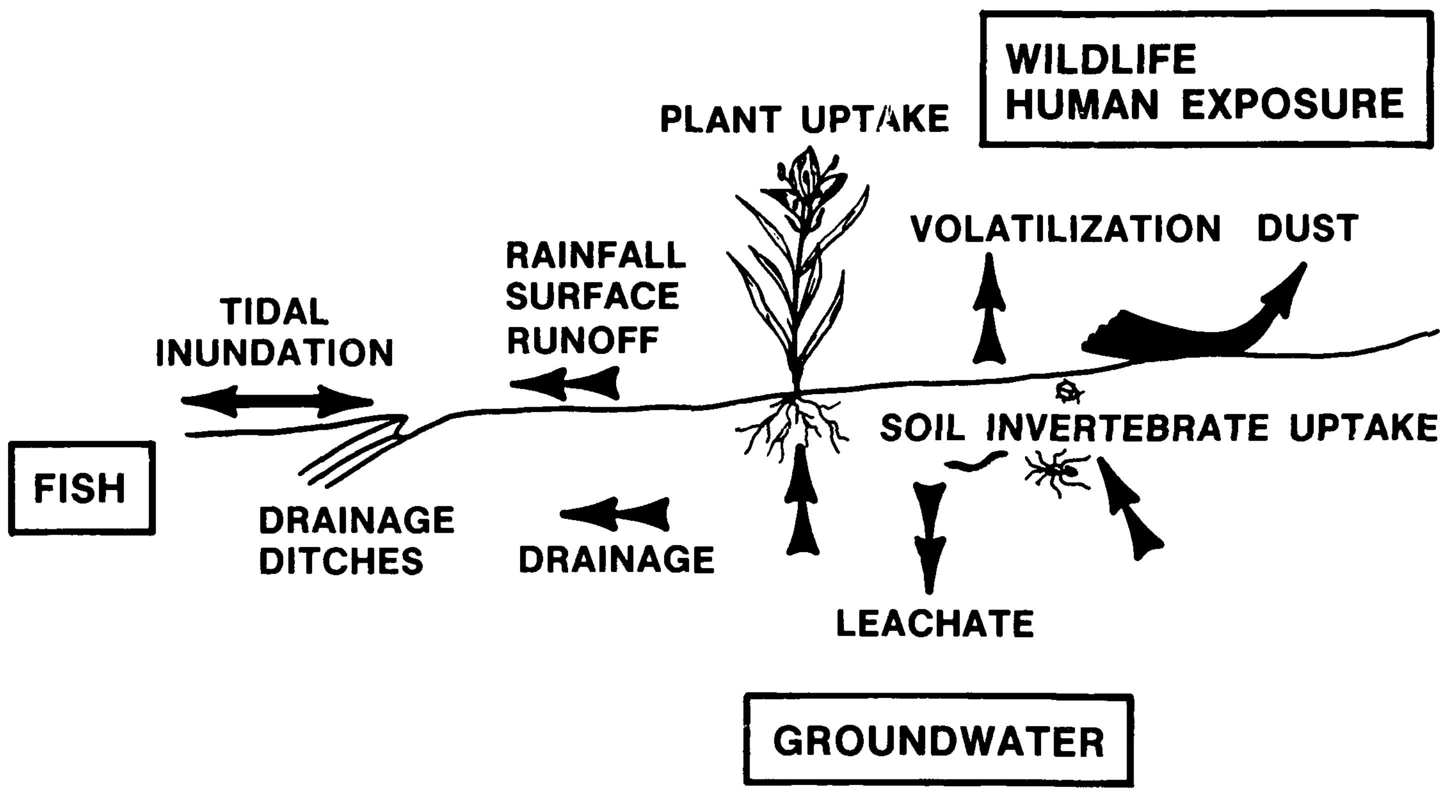

Plate 3.1. Pathways for contaminant mobility.

Additional data on the distribution of metals in soils, collected by WES from June 1984 to January 1986, is summarized in the Final Report of Remedial Investigation of Contaminant Mobility at the Naval Weapons Station, Concord, CA (Lee et al. 1986). These data include TTLC for seven (7) metals (arsenic, cadmium, copper, nickel, lead, selenium, and zinc) for 312 samples collected from 248 locations in the seven (7) areas making up RASS 1, RASS 2, RASS 3, and RASS 4. Subsequent to the issuance of that report, additional analyses were carried out by WES during June and December 1986 to further define the extent of metal contamination and potential mobility of metals on the seven (7) areas composing RASS 1, RASS 2, RASS 3, and RASS 4. These included 225 TTLC analyses of samples collected from 180 locations and 145 STLC analyses of samples collected from 126 locations. These TTLC and STLC analyses focused on five (5) metals (arsenic, cadmium, copper, lead, and zinc) which were deemed to be of particular concern based upon previous studies. The locations of all sampling points are summarized in Drawings 6, 7, 8, 17, and 22 (US Navy 1987).

Horizontal Distribution of Metals and Arsenic in Surface Soils. The extensive sampling of soils conducted to date enables evaluation of the horizontal distribution of hazardous substances in the surface soils on and near RASS 1, RASS 2, RASS 3, and RASS 4.

For RASS 1, the Draft Confirmation Study Report showed that at seven (7) of twenty-two (22) locations the arsenic concentrations exceeded the TTLC criterion for that metal (14U, 14V1, 14W1, 16W1, 16V1, 16V1, and 16T2) (Anderson Geotechnical Consultants 1984) (Drawing 9). In order to better define the limits of the arsenic contamination and to determine if other metals exceeded the TTLC criterion, more extensive sampling of RASS 1 was carried out by WES in 1984, 1985, and 1987 (Drawing 10). In these studies, seven (7) samples were found to exceed the TTLC criterion for arsenic (16U8, 16U7, 16V1, 16W2, 16W1, 16X2, and 16X6) (Drawing 10). The general pattern of arsenic contamination in the WES samples was consistent with that of the Draft Confirmation Study Report (Drawings 9 and 10). Moreover, the extensive sampling of the WES studies effectively delineated the boundaries of arsenic contamination for RASS 1, as defined by the TTLC criterion.

Measurements of STLC were also performed on soil samples obtained from RASS 1 during the 1986 studies by WES (Drawing 11). In these studies, samples collected from twenty-six (26) locations were found to exceed the STLC criterion for arsenic (15Q2, 15R2, 15S1, 15S2, 16U8, 16U7, 16U2, 16U5, 16U6, 16V1, 16V2, 16W1, 16W2, 16W3, 16W4, 16X4, 16X3, 16X5, 16X6, 16V3, 16U3, 16U4, 14S1C, 12S1, 12T1, and 10T1) (Drawing 11).

Use of the STLC criterion suggests that the distribution of elevated concentrations of soluble arsenic in the soils of RASS 1 is more extensive than indicated by the TTLC criterion. The locations which exceed STLC for RASS 1 are well contained by the sampling grid with the exception of samples 12T1 and 10T1, which lie along a ditch on the western boundary of the grid (Drawing 11). The high STLC arsenic concentrations in these samples may reflect sediment migration along the ditch. Further STLC samples will be taken in this area to define the horizontal limits of contamination by the STLC criterion (Drawing 45).

Copper concentrations exceeded the STLC criterion at two (2) locations in RASS 1, suggesting significant but localized copper contamination at that location (Drawing 10) (15Q1 and 15Q2) (Drawing 11). Lead concentrations also exceeded the STLC criterion at one (1) of the same locations (15Q1). None of the other metals measured in these studies exceeded the TTLC or STLC criteria in samples taken from locations in RASS 1 (Drawings 9, 10, and 11).

In RASS 2, the data from the Draft Confirmation Study Report (1984) indicated that samples from four (4) locations on the southern boundary of RASS 2 exceeded the TTLC criterion for arsenic (12P1, 12P2, 11P3, and 11P5) (Drawing 9). The TTLC analyses performed by WES in 1984 and 1986 revealed only a single sample in the same general location which exceeded the TTLC criterion for arsenic (11Q2D1) (Drawing 10). In the STLC analyses, samples from five (5) locations in the same area of RASS 2 exceeded the STLC criterion for arsenic (11Q1D1, 11Q3D1, 11R4D1, 11Q2D1, and 11R9D1) (Drawing 11). A final sample, along the boundary between RASS 2 and RASS 1, also exceeded the STLC criterion for arsenic (11R3) (Drawing 11). These data indicate that arsenic contamination in RASS 2 is well defined and localized.

Cadmium in RASS 2 exceeded the TTLC criterion at two (2) locations in the Draft Confirmation Study Report (10Q6 and 10Q8) (Drawing 9). The WES studies of 1984, 1985, and 1986 found no samples from RASS 2 which exceeded the TTLC criterion for cadmium (Drawing 10). In the STLC analyses conducted by WES in 1986, however, eight (8) samples exceeded the STLC criterion for cadmium (9Q3D1, 9Q2D1, 10Q2D1, 10Q1D1, 10R5D1, 11R6D1, 10R6D1, and 10R1) (Drawing 11). One of these samples (10R1) was at the northern boundary of the sampling grid. Further STLC samples will be taken in that area to define the limits of the area which exceeds the STLC criterion for cadmium (Drawing 45).

Copper concentrations in samples from RASS 2 did not exceed the TTLC criterion at any of the locations in the Draft Confirmation Study Report or the WES studies (Drawings 9 and 10). Copper did exceed the STLC criterion at two locations (10Q1D1 and 10R5D1) (Drawing 11), indicating limited and well defined copper contamination in the soils of RASS 2.

The concentrations of lead in RASS 2 exceeded the TTLC criterion at seventeen (17) locations in the Draft Confirmation Study Report (9R2, 10Q4, 10Q2, 9Q1, 9Q3, 10Q3, 10Q8, 10Q1, 10Q7, 10P4, 10Q12, 10Q13, 10R7, 10Q5, 10P2, 10Q6, and 12P1) (Drawing 9) and at two (2) locations in the WES studies (10Q2D1 and 10P1) (Drawing 10). Six (6) locations in RASS 2 also exceeded the STLC criterion for lead (10Q2D1, 9Q2D1, 10R5D1, 10R4, 10R3, and 10R7D1) (Drawing 11). One (1) of these samples (10R7D1) was located at the northern boundary of the sampling grid. Further STLC samples will be taken in that area to define the limits of the area which exceeds the STLC criterion for lead (Drawing 45).

The concentrations of zinc in samples from RASS 2 exceeded the TTLC criterion at eight (8) locations in the Draft Confirmation Study Report (9Q3, 9Q2, 9Q1, 10Q8, 10Q7, 10P4, 10Q13, and 11R3) (Drawing 9) and at six locations in the WES studies (9Q3D1, 10Q2D1, 10P1, 9Q2D1, 9Q1, and 10R5D1) (Drawing 10). The STLC criterion for zinc was exceeded at the six (6) locations (9Q3D1, 10Q2D1, 10Q1D1, 9Q2D1, 10R6D1, and 10R5D1) (Drawing 11). These data indicated significant, but localized, contamination of zinc in the soils of RASS 2.

In RASS 3, only one (1) sample in the Draft Confirmation Study Report exceeded the TTLC criterion for arsenic (10O1) (Drawing 18). No samples taken from

RASS 3 in the WES studies exceeded the TTLC or STLC criteria for arsenic (Drawing 19 and 20). These data indicated the possibility of very localized arsenic contamination at one location in RASS 3.

The concentration of cadmium in samples from RASS 3 exceeded the TTLC criterion at only one (1) location in the Draft Confirmation Study Report (8P3) (Drawing 18), and did not exceed the TTLC criterion at any of the locations sampled in the WES studies (Drawing 19). The STLC criterion for cadmium was exceeded at seven (7) locations in the 1986 WES studies (13L6, 14L3, 12N1, 11O1, 6P1, 6P2, and 5P2) (Drawing 20). The STLC data indicated significant and widespread cadmium contamination in RASS 3. Because three samples at the west end of RASS 3 (6P1, 6P2, and 5P2) (Drawing 20) were at the boundary of the existing sampling grid, further sampling and STLC analysis for cadmium will be carried out in that area (Drawing 46).

The concentrations of copper in samples from RASS 3 exceeded the TTLC criterion at one location in the Draft Confirmation Study Report (8P10) (Drawing 18), and did not exceed the TTLC criterion at any of the locations sampled in the WES studies (Drawing 19). The STLC criterion for copper was exceeded at four (4) locations in the 1986 WES studies (13L6, 12N1, 6P1, and 6P2) (Drawing 20). The STLC data indicated significant, but localized, copper contamination in RASS 3. Because two (2) samples at the west end of RASS 3 (6P1 and 6P2) (Drawing 20) were at the boundary of the existing sampling grid, further sampling and STLC analysis for copper will be carried out in that area (Drawing 46).

Lead in RASS 3 exceeded the TTLC criterion at twelve (12) locations in the Draft Confirmation Study Report (11O2, 10P1A, 10P1B, 9P1, 8P9, 8P10, 8P8, 8P1, 8P6, 8P7, 8P3, and 5P1) (Drawing 18). In the WES studies of 1984, 1985, and 1986, samples from eight (8) locations in RASS 3 exceeded the TTLC criterion for lead (13J1, 13L6, 14L2, 12N1, 10P1, 8P1, 6Q1 and 6P2) (Drawing 19). In the STLC analyses conducted by WES in 1986, nineteen (19) samples exceeded the STLC criteria for lead (13K2, 13L6, 14L2, 13M5, 14L3, 14M4, 13M1, 12M6, 12M5, 12N5, 12O1, 12N1, 11O1, 10P2, 6Q1, 6Q2, 6P1, 6P2, and 5P2) (Drawing 20). These data indicated extensive lead contamination in the soils of RASS 3. Further sampling will be required in the western portion of RASS 3 to define

the extent to which the soils in that area exceed the STLC criterion for lead (Drawing 46).

The concentrations of zinc in samples from RASS 3 exceeded the TTLC criterion at seventeen (17) locations in the Draft Confirmation Study Report (13J1, 13L4, 12O1, 11O3, 11O2, 11O4, 11O5, 9P1, 8P10, 8P9, 8P8, 8P2, 8P7, 8P6, 8P1, 6Q2, and 5P1) (Drawing 18), at the two (2) lagoon sampling locations on Chemical and Pigment Company property (14J1 and 14K1) (Drawing 18); and at sixteen (16) locations sampled in the WES studies (13J1, 13L6, 13L1, 14L1, 13M1, 12N1, 12O1, 11O1, 10P1, 8P1, 8P2, 8P3, 6Q1, 6P1, 6P2, and 5P2) (Drawing 19). The STLC criterion for zinc was exceeded at fifteen (15) locations in the 1986 WES studies (13K2, 14L2, 14L3, 13L6, 13M1, 12O1, 12N1, 11O1, 10P2, 6Q1, 6P2, 6P1, 6Q2, 5P2, and 3R1) (Drawing 20). These data indicated extensive zinc contamination in the soils of RASS 3. Further sampling and STLC analyses will be required in the western portion of RASS 3 to define the extent to which the soils in that area exceed the STLC criterion for zinc (Drawing 46).

The Draft Confirmation Study Report TTLC data for RASS 4 were taken prior to a partial removal of contaminated soil from that subsite in August 1983, and are not indicative of current conditions. The WES studies were carried out following the removal (Drawing 23). No samples taken in the WES studies exceeded the TTLC criterion for arsenic (Drawing 23). The STLC criterion for arsenic, however, was exceeded in samples from four (4) locations in RASS 4 (28F1, 26F1, 26G3, and 26G4) (Drawing 23). These data indicated some localized arsenic contamination in RASS 4, which is well delineated by the existing data.

The concentrations of cadmium did not exceed the TTLC criterion at any of the locations in RASS 4 sampled in the WES studies (Drawing 23). The STLC criterion for cadmium was exceeded at five (5) locations in RASS 4 in the 1986 WES studies (29E2, 26F1, 26F2, 26G5, and 26G4) (Drawing 24). STLC data indicated significant cadmium contamination in RASS 4. Because three samples at the west end of RASS 4 (26F2, 26G5, and 26G4) (Drawing 24) were at the boundary of the existing sampling grid, further sampling and STLC analysis for cadmium will be carried out in that area (Drawing 47).

The concentrations of copper in samples from RASS 4 did not exceed the TTLC or STLC criteria at any of the locations sampled in the WES studies (Drawings 23 and 24). These data indicate that there is no significant copper contamination in the soils of RASS 4.

Lead in RASS 4 exceeded the TTLC criterion at three (3) locations in the WES studies of 1984, 1985, and 1986 (29E11, 29E6, and 28F1) (Drawing 23). In the STLC analyses conducted by WES in 1986, six (6) samples exceeded the STLC criterion for lead (29E11, 29E6, 29E12, 29E7, 28F1, and 29F3) (Drawing 24). These data indicated localized lead contamination in the soils of RASS 4, which is well defined by the existing data.

The concentrations of zinc in samples from RASS 4 did not exceed the TTLC or STLC criteria at any of the locations sampled in the WES studies (Drawings 23 and 24), indicating no significant zinc contamination in the soils of RASS 4.

The concentrations of selenium exceeded the TTLC criterion at two (2) of the locations in RASS 4 sampled in the WES studies (29F1 and 29E1) (Drawing 23). The STLC criterion for selenium was exceeded at one (1) location in RASS 4 in the 1986 WES studies (29F1) (Drawing 24). These data indicated localized selenium contamination in the soils of RASS 4, which is well defined by the existing data.

In summary, RASS 1 has extensive arsenic contamination and localized lead and copper contamination. The horizontal extent of arsenic contamination is generally well defined by the current data, but more STLC analyses will be required in the area to the west of station 10T1 out as far as station 7T4 (Drawing 45). RASS 2 has extensive lead, cadmium, and zinc contamination and more limited copper and arsenic contamination. The distributions are generally well defined by the existing data, but additional STLC analyses will be required to define the limits of lead and cadmium contamination to the north of station 10R1 (Drawing 45). RASS 3 has extensive zinc, lead, and cadmium contamination and more limited copper and arsenic contamination. Additional STLC analyses will be required to define the limits of this contamination in the southwest section of RASS 3 (Drawing 46). RASS 4 has significant cadmium and lead contamination and more limited arsenic and selenium contamination.

Further STLC analyses will be required to define the western limits of cadmium contamination in the soils of RASS 4 (Drawing 47).

Vertical Distribution of Potentially Hazardous Metals and Arsenic in Soils. Several studies examined the vertical distribution of potentially hazardous metals in the soils of RASS 1, RASS 2, RASS 3, and RASS 4. Data from studies by PEL and Brown and Caldwell were summarized in the Draft Confirmation Study Report (Anderson Geotechnical Consultants 1984). In these studies, data were available on six (6) soil core samples in RASS 2 (9Q1, 10Q7, 10Q8, 10Q9, 10P4, and 12P2) (Drawing 14); five (5) in RASS 3 (8P7, 8P6, 1103, 1201 and 13L4) (Drawing 21); and five (5) in RASS 4 (28E5, 29E15, 29F3, 29E5, and 29E7) (Drawing 48). These core samples were analyzed for arsenic, cadmium, copper, lead, selenium, and zinc concentrations (TTLC) at depths of 0-6 inches, 12-18 inches, and in some samples 18-36 inches. This report also presented data on the same six (6) metals at depths of 12-18 inches for nine (9) locations in RASS 1 (16V1, 14U1, 16T1, 14S1, 15S2, 15R1, 14R1, 15Q2, and 14Q1) (Drawing 14); nine (9) locations in RASS 2 (10R7, 11R3, 11Q1, 12Q1, 10Q13, 11Q2, 12P5, 10Q12, and 10Q10) (Drawing 14); fifteen (15) locations in RASS 3 (4R1, 6Q2, 6P2, 8P3, 901, 1101, 11M1, 10M3, 10M2, 10M1, 10L1, 13N1, 13M1, 12M1, and 12M2) (Drawing 21); and five (5) locations in RASS 4 (29E15, 29F3, 29E5, 28E5, and 29E7) (Drawing 48).

In these studies, no contamination was found below 6 inches in RASS 1. However, zinc exceeded the TTLC criterion at soil depths below 12 inches at three (3) locations in RASS 2 (11R3, 10Q13, and 10Q12) (Drawing 14); and at two (2) locations in RASS 3 (8P6 and 1201) (Drawing 21). At all three (3) of the locations in RASS 2, zinc in soils from the greatest depth sampled (12-18 in.) exceeded the TTLC criterion (11R3, 10Q12, and 10Q13) (Drawing 14). Lead exceeded the TTLC criteria at soil depths below 12 inches at two (2) locations in RASS 2 (10Q13 and 10Q12) (Drawing 14), but at none of the locations in RASS 3 (Drawing 21). At both locations in RASS 2, lead exceeded the TTLC criteria in soils from the greatest depth analyzed (12-18 inches at 10Q12 and 10Q13) (Drawing 14). The TTLC criterion for the six (6) metals was not exceeded in any of the other soil samples taken below 12 inches. These data indicated that, with the exception of zinc and lead in three (3) locations in RASS 2 and at two (2) locations in RASS 3, metal contamination in

the soils of RASS 1, RASS 2, RASS 3, and RASS 4 is limited to the top 12 inches.

In RASS 4 the concentrations of selenium exceeded the TTLC criterion at three (3) locations in the surface soil at 0-6 inches depth (29E5, 29F3, and 29E15) (Drawing 48). The concentrations of lead also exceeded TTLC criteria at one (1) of those locations (29E15). At one (1) location (29E7), the concentrations of selenium and lead exceeded the TTLC criterion at the greatest depth sampled (6-12 inches).

A subsequent study was carried out by WES in December 1986 to better define the vertical extent of zinc and lead contamination in RASS 2.

Thirty-nine (39) locations were sampled in RASS 2 at depths of 0-6 inches, 6-12 inches, 12-24 inches, and 24-36 inches, and analyzed for TTLC and STLC (Drawings 15 and 16). In this study, zinc exceeded the TTLC criterion at depths below 12 inches at three (3) locations (10R5, 10Q2, and 9Q3) (Drawing 15). At two (2) of these locations (10R5 and 9Q3) (Drawing 15), zinc exceeded the TTLC criterion in the deepest sample analyzed (24-36 inches). Lead exceeded the TTLC criterion at depths below 12 inches at two (2) locations in RASS 2 (10R5 and 10Q2). At one of these locations (10R5), lead exceeded that criterion at a depth of 24-36 inches.

In addition, zinc exceeded the STLC criterion at depths below 12 inches at six (6) locations (10R6, 10R5, 9Q3, 10Q2, 10Q1, and 13R1) (Drawing 16), and at three (3) of these locations (10R5, 9Q3, and 10Q2) zinc exceeded the STLC criterion at a depth of 24-36 inches. Lead exceeded the STLC criterion at depths below 12 inches at four (4) locations (10R5, 9Q2, 10Q2, and 10Q1) (Drawing 16), and at three (3) of these locations (10R5, 9Q2, and 10Q1) lead exceeded the STLC criterion at a depth of 24-36 inches. Copper exceeded the STLC criterion at depths below 12 inches at four (4) locations (1101, 11Q2, 11R9, and 13R1) (Drawing 16), and at one of these locations (11Q1) copper exceeded the STLC criterion at a depth of 24-36 inches. Cadmium exceeded the STLC criterion at depths below 12 inches at seven (7) locations (11R6, 10R6, 10R5, 11R4, 9Q3, 11Q2, and 13R1) (Drawing 16), and at five (5) of these locations (13R1, 11Q2, 10R5, 10R6, 11R6, and 9Q3) cadmium exceeded the STLC

criterion at a depth of 24-36 inches. Arsenic exceeded the STLC criterion at depths below 12 inches at three (3) locations (11Q1, 11Q2, and 11R9) (Drawing 16), and at two (2) of these locations (11Q1 and 11R9) arsenic exceeded the STLC criterion at the greatest depth sampled (24-36 inches). These data indicated that eleven (11) locations in RASS 2 (11R6, 10R6, 10R5, 9Q2, 9Q3, 10Q2, 10Q1, 11Q1, 11Q2, 13R1, and 11R9) (Drawing 16) exceeded the STLC criterion for zinc, lead, copper, or cadmium at the greatest depth sampled (24-36 inches). Additional soil samples will be taken at these locations during active remediation to further define the vertical distribution of these metals.

In summary, the vertical distribution of potentially hazardous metals in the soils of RASS 1, RASS 2, RASS 3, and RASS 4 is generally well defined and limited to the top 12 inches. In a few localized areas of RASS 2 and RASS 3, however, zinc, lead, copper, and cadmium contamination extends below 12 inches and in some instances exceeds the TTLC or STLC criteria at the greatest depth analyzed. Further sampling will be carried out at these locations during remediation to determine the vertical extent of these metals.

Potentially Hazardous Organics in Soil. In 1984, samples from RASS 1, RASS 2, RASS 3, and RASS 4 were analyzed for extractable organic priority pollutants (Anderson Geotechnical Consultants 1984). The locations of these samples are shown in Figure 36, Figure 37, and Drawing 38. These samples were taken at a depth of 0-6 inches and were analyzed by gas chromatography/mass spectrometry as specified by the California Assessment Manual (Department of Health Services 1984). All of the extractable priority pollutants were below detection limits at five (5) of the six (6) locations sampled. At one location (10M1) located in RASS 3 (southeast corner of Parcel 574 on NWS Concord) (Drawing 38), five (5) priority pollutants were detected at concentrations ranging from 200-300 ppb. The compounds that were detected at this site were fluoroanthene, pyrene, benzo(a)anthracene, chrysene, and benzo (b) and (k) fluoranthene. As part of the same study, individual samples from RASS 1 (Drawing 36) were also analyzed by gas chromatography/mass spectrometry for purgable organic priority pollutants using EPA method 8270 (The Methods for Evaluating Solid Waste, SW-846, July 1982). The concentrations of all of the purgable priority pollutants were below detection limits at both locations.

3.1.1.2 Potential for Contaminant Migration. There is potential for direct contact with contaminated materials on site. Potential receptors include personnel working at the site during remedial activities, general site trespassers, and personnel employed at adjacent industrial and agricultural activities. The potential for direct contact is reduced somewhat by the isolated locations of several of the sites and land use controls implemented by the Navy.

3.1.2 Biological Uptake and Accumulation by Soil Contact.

3.1.2.1 Assessment of Current Biological Uptake and Accumulation. Uptake of contaminants by plants and animals was documented in the RI (Lee et al. 1986) and in O'Neil (1988). Bioaccumulation studies were conducted on RASS 1 and RASS 2 using earthworms, plants, clams, mice, and voles.

Plant Bioaccumulation. Plant uptake of contaminants were extensively reported in the RI (Lee et al. 1986).

Earthworm Bioaccumulation. Earthworm bioaccumulation studies were extensively reported in the RI (Lee et al. 1986).

Clam Bioaccumulation. Clam bioaccumulation studies were extensively reported in the RI (Lee et al. 1986) and a detailed analysis of the relationship between clam bioaccumulation and surface water quality is presented in Section 3.1.3.

Mice and Vole Bioaccumulation. Bioaccumulation studies on mice and voles were reported by O'Neil (1988). Significant bioaccumulation of cadmium, lead, and selenium was found in mice and voles. Arsenic was found in tissue of mice and voles; however, the concentrations detected were not significantly higher than those found in similar animals from reference areas.

3.1.2.2 Potential for Contaminant Migration. This pathway of contaminant mobility is related to biological uptake and accumulation. Potential release of contaminants can occur through plant uptake and may result in an accumulation of contaminants at levels exceeding normal tissue contents.

Animals feeding upon contaminated plants are at higher risk of becoming contaminated than animals feeding on uncontaminated plants in the same locale. Potential release of contaminants can occur through uptake by soil-dwelling animals. Wildlife species whose diets consist of soil invertebrates may ingest contaminated organisms, accumulating contaminants to levels that result in adverse physiological effects.

Contaminant mobility into aquatic ecosystems commences with rainfall-initiated surface runoff or movement of detritus and soluble contaminants into drainage ditches and subsequently into Suisun Bay through the actions of tidal inundation. Surface drainage also introduces soluble contaminants into the aquatic ecosystem. Fish are potentially exposed to any influx of contamination into the aquatic environment by feeding upon fauna and detritus from flora that may have accumulated contaminants.

Ground water contamination can potentially occur from soil moisture leaching through the soil profile into the ground water aquifer. Contaminants must be in a soluble and mobile form to leach through the soil profile. The interactive effects of plant uptake, soil invertebrate absorption, and adsorption to soil particles and organic matter provides a rather efficient biological filter to clean leachate as it penetrates the soil profile. However, as plants and soil invertebrates die and decompose, contaminants are released and can be susceptible to leaching into the ground water.

3.1.3 Surface Water.

3.1.3.1 Assessment of Current Surface Water Conditions.

Distribution of Potentially Hazardous Metals in Surface Waters. Several studies provide information on the concentration and distribution of hazardous metals in surface waters on and near RASS 1, RASS 2, RASS 3, and RASS 4. These include the 1983 study by Pacific Environmental Laboratories (PEL) and the 1985 study by Brown and Caldwell. The locations of these sampling stations and the relevant data from these studies are summarized in Drawings 25, 26, and 27 (US Navy 1987). The data from RASS 1, RASS 2, and RASS 3 are reviewed together as the surface waters on these sites are interconnected.

The surface water samples taken from RASS 1 were from standing water following a rainfall event. Surface waters sampled on RASS 2 included tidal wetlands along the northern border and standing water following a rainfall event. Surface waters sampled in RASS 3 included the lower portion of Nichols Creek which flows adjacent to the Chemical and Pigment Company facility, and a fresh water wetland adjacent to the creek.

In RASS 3, the concentrations of zinc exceeded the national acute water quality criteria (US EPA 1986c) for zinc in three (3) of the four (4) locations in the creek (002L, 003L, and G1-3) and in four (4) of five (5) locations in the wetland (G1-1, G1-2, K2-2, and K2-1) (Drawing 25).[1] The concentrations of zinc in surface waters also exceeded the acute water quality criteria at three (3) of seven (7) locations in RASS 2 (K-3, K-2, and K-1) (Drawing 26) and at four (4) of the five (5) locations sampled in RASS 1 (B1, B2, A2, and A3) (Drawing 26).

The concentrations of copper were found to be in excess of national acute water quality criteria at one (1) of four (4) locations in the creek (002L) and at two (2) of five (5) locations in the wetlands of RASS 3 (G1-1 and K2-2) (Drawing 25). Copper concentrations also exceeded the acute or chronic criteria at three (3) of seven (7) locations in RASS 2 (K1, K2, and K3) (Drawing 26) and at four (4) of the five (5) locations in RASS 1 (B1, B2, A2, and A3) (Drawing 26).

Cadmium concentrations exceeded national acute water quality criteria at two (2) of the five (5) locations in the wetlands of RASS 3 (G-11 and K2-1) (Drawing 25), at three (3) of seven (7) locations in RASS 2 (K1, K2, and K3) (Drawing 26), and at four (4) of the five (5) locations in RASS 1 (B1, B2, A2, and A3) (Drawing 26).

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[1] The acute and chronic criteria for zinc and the other metals discussed in this section are derived from the current water quality criteria documents for each metal (US EPA 1986c) and assume a hardness of 100 mg/l.

The concentrations of lead were below national chronic water quality criteria for all locations in RASS 3 (Drawing 25), but exceeded chronic criteria at all seven (7) locations in RASS 2 (K1, K2, K3, 11P5, 10R3, 10Q2, and 9R2) (Drawing 26) and at four (4) of the five (5) locations in RASS 1 (A2, A3, B1, and B2) (Drawing 26).

The concentrations of arsenic exceeded the national acute water quality criteria at three (3) of seven (7) locations in RASS 2 (K3, 11P5, and 10R3) (Drawing 26) and at two (2) of five (5) locations in RASS 1 (A2 and A3) (Drawing 26). Nickel exceeded the acute criteria at two (2) of seven (7) locations in RASS 2 (K1 and K3) (Drawing 26) and at four (4) locations in RASS 1 (A2, A3, B1, and B2) (Drawing 26).

These data show that there is significant zinc, copper, cadmium, and lead contamination in the surface waters of RASS 1, RASS 2, and RASS 3. Since these data are all based on total acid extractable measurements, rather than dissolved measurements, they may overestimate the actual concentration of bioavailable metals in the surface waters. The issue of metal bioavailability is addressed more directly by the clam biomonitoring data which are discussed below.

From the existing water quality data, it is difficult to determine the potential for movement of these metals from RASS 1, RASS 2, and RASS 3 into the wetlands north and west of these areas or Suisun Bay. Zinc was not detected in the one (1) sample in the creek north of RASS 3, but the high detection limit of that analysis reduces the usefulness of those data (Drawing 26). The clam biomonitoring data discussed later in this section provide further information about zinc movement into adjacent wetlands and the Bay.

In RASS 4, a surface water sample was collected from the wetlands to the northwest of the RASS, and standing water samples were collected following a rainfall event. Concentrations of lead were found to exceed the chronic water quality criteria at three (3) of the four (4) locations where standing water was examined (30E1, 30F2, and 30F3) (Drawing 27), while copper concentrations exceeded the acute criteria at the one (1) site in the wetlands (30G1) (Drawing 27). Concentrations of selenium exceeded chronic water quality criteria

at two (2) of three (3) locations where standing water was examined (30F2 and 30E1) (Drawing 27). These data suggested potential lead, copper, and selenium contamination in the surface waters of this site. Since these measurements are based on total acid extracts rather than dissolved, it is difficult to evaluate the potential bioavailability of these metals based on these data. Furthermore, with the limited number of samples, it is likewise difficult to determine the potential for movement of these metals into the wetlands.

Potentially Hazardous Organics in Surface Water. Surface water samples from three (3) locations were also analyzed for organic priority pollutants (PEL 1983). These samples were located in the wetlands northeast of RASS 4 (PEL sample #15), the wetlands in RASS 3 (PEL sample #5), and the creek west of RASS 1 and 2 (PEL sample #21). These samples are well located to assess the input of hazardous organic substances into the wetlands (Drawings 36, 37, and 38). With the exception of two phthalate compounds (bis(2-ethylhexyl) phthalate and Di-n-Butyl phthalate), none of the organic priority pollutants were detected in these samples. The phthalate compounds were present at concentrations of 2-4 ppb in the samples from the wetlands of RASS 3 and the creek west of RASS 1 and RASS 2. It is important to note that these phthalate compounds are common laboratory contaminants and it is thus difficult to determine the environmental significance of low concentrations of these compounds in the PEL samples.

Clam Biomonitoring Studies. Surface water quality was also evaluated more directly through biomonitoring techniques in which clams (*Corbicula fluminea*) were used to evaluate the toxicity and bioaccumulation of metals suspended in the surface water on site. In these studies, clams were placed in plastic cages (10 organisms per cage) and the cages were suspended in the surface water for a 28-day period of exposure. Since this clam is a filter feeder and passes large quantities of water and suspended particulates through its gills and digestive system, it serves as an excellent indicator of the potential for bioaccumulation of water-borne contaminants. Because this species can accumulate both dissolved metals and metal associated with fine suspended particulates, it tends to overestimate the actual bioavailable fraction of metals thus making it an ecologically conservative monitoring tool. The clam biomonitoring assay is analogous to the approach used extensively in the

national Status and Trends or "Mussel Watch" program which is used to screen for bioavailable contaminants in coastal waters around the world.

An initial clam biomonitoring study was carried out by WES in 1984 and is summarized in the Final Report of the Remedial Investigation of Contaminant Mobility (Lee et al. 1986) (Drawing 28). In this study, clams were placed at twenty-eight (28) locations including seven (7) locations in Nichols Creek (14F1, 13H1, 13J1, 13K1, 13L1, 13L4, and 13M1) (Drawings 28 and 29); at three (3) locations in the wetlands of RASS 3 (12N2, 8P3, and 4R1) (Drawing 28 and 29); at three (3) locations in the wetlands of RASS 1 (16V4, 16V3, and 16V2) (Drawings 28 and 6); at three (3) locations where the wetlands drain into the Pier 4 slough (1246, 1242, and 1243) (Drawings 28 and 31); at two (2) locations to the west of the Pier 4 slough (1241 and 1245) (Drawings 28 and 31); at one (1) location where the Pier 4 slough drains into Suisun Bay (1244) (Drawings 28 and 31); and at three (3) locations along the shore of the Bay just north of RASS 1 (16Z1, 16Z4, and 16Z6) (Drawings 28 and 32). Clams were also placed at four (4) upland reference locations which are located in Nichols Creek upstream of known sources of contamination (BK1331, BK1332, BK1333, and BK1334) (Drawings 28) and at two (2) wetland reference locations which are west of any known wetlands contamination (BK1161 and BK1162) (Drawing 28). Following the 28-day exposure period, mortality was recorded and the tissues of the surviving organisms were analyzed for arsenic, cadmium, copper, nickel, lead, selenium, and zinc.

A second clam biomonitoring study was carried out by WES in 1986 following the extensive winter flooding event. Clams were placed at thirty-two (32) locations including fifteen (15) locations which had been sampled in the 1984 study and at seventeen (17) new locations. This study included four (4) locations in Nichols Creek (14F1, 13J1, 13L1, and 13M1) (Drawing 29); two (2) locations in the wetlands of RASS 3 (12N2 and 4R1) (Drawing 29); four (4) locations in the wetlands of RASS 2 (12S1, 10R5, 8S2, and 6S1) (Drawing 30); eleven (11) locations in the wetlands of RASS 1 (10S3, 10T1, 12V1, 12W2, 7R1, 6R1, 7T4, 7T3, 5U1, 8W2, and 5W2) (Drawing 30); five (5) locations where the wetlands drain into the Pier 4 slough (1248, 1247, 1246, 1242, and 1243) (Drawing 31); two (2) locations to the west of the Pier 4 slough (1241 and 1245) (Drawing 31); one (1) location where the Pier 4 slough drains into

Suisun Bay (1244) (Drawing 31); one (1) upland reference site along Nichols Creek (BK1332) (Drawing 28), and two (2) wetland reference locations (BK1161 and BK1162) (Drawing 28). Following 28-days of exposure, mortality was recorded and the tissues of the surviving organisms analyzed for arsenic, cadmium, copper, lead, and zinc.

The locations of clams from both the 1984 and 1986 WES studies are presented in Drawings 29, 30, 31, and 32, as are the concentrations of arsenic, cadmium, lead, and zinc for the clam tissues from these locations. Because metal bioaccumulation standards are not available for clams, the concentrations of metals in the tissues were compared statistically with those of reference locations using analysis of variance and the Duncans multiple range test. The concentrations of zinc and cadmium in clams from the reference areas in the WES study compare well with concentrations for those same metals from native Corbicula from sites in Suisun Bay (Luoma et al. 1984), indicating that these concentrations represent an appropriate background range. No comparable data are available for lead.

For the 1984 samples, concentrations of cadmium, lead, and zinc greater than 1.39, 3.21, and 200 mg/kg, respectively, were determined to be significantly elevated relative to reference locations. By these criteria, significant bioaccumulation of lead was limited to five (5) locations in the creek and wetlands of RASS 3 (13L1, 13L4, 13M1, 12N2, and 8P3) (Drawing 29). The concentrations of lead in those samples ranged from 3.2 to 6.1 mg/kg or about 10 times the range of concentrations found in clams from reference areas (0.3-1.0 mg/kg) (Drawing 31). Clams from these same five (5) locations also showed significant bioaccumulation of zinc (Drawing 29). The concentrations of zinc in these samples ranged from 200 to 256 mg/kg, which is about twice the range of samples from the reference area (106 to 129 mg/kg) (Drawing 31).

Concentrations of lead and zinc in clam tissues were not significantly higher than those from the reference areas for clams from any of the other locations in the study, including those in RASS 1 and along the creek to the west of RASS 1 (Drawings 30 and 31), those along the Pier 4 slough (Drawing 31), or those on the shore of Suisun Bay (Drawing 32). The lack of significant accumulation of lead and zinc in clams from locations closer to the Bay indicated

that the impact of the lead and zinc contamination from RASS 3 on the water quality of the Bay should be minimal under the flow conditions that preceded the 1984 sampling.

Significant bioaccumulation of cadmium was detected at one (1) location in the creek in RASS 3 (13L4) (Drawing 29), as well as at two (2) locations in the creek near the Pier 4 slough (1242 and 1243) (Drawing 31). The concentrations of cadmium in these samples ranged from 1.4 to 2.0 mg/kg, about twice the concentration range found in samples from the reference locations (0.6 to 0.9 mg/kg) (Drawing 31). Significant bioaccumulation of cadmium in the samples near the Pier 4 slough suggested some movement of bioavailable cadmium through the wetland toward the Bay. The lack of significant bioaccumulation of cadmium in clams at the mouth of Pier 4 slough (1244) (Drawing 31), however, indicated that there is no movement of bioavailable cadmium out of the slough into the Bay itself under these flow conditions. No significant accumulation of arsenic, copper, or selenium was detected in clams from any of the locations examined in the 1984 WES study when compared with reference locations.

The 1986 clam biomonitoring study was carried out following extensive winter flooding. The results from this study were indicative of the potential for resuspension and redistribution of metals from contaminated soils under flood conditions. For these samples, concentrations of arsenic, cadmium, lead, and zinc greater than 2.13, 3.26, 5.46, and 183 mg/kg, respectively, were determined to be significantly greater than the reference locations.

In the 1986 study, significant accumulation of lead was limited to two (2) locations in RASS 3. The first sample was from Nichols Creek (13M1) (Drawing 29) and the second was from the wetland adjacent to Nichols Creek (12N2) (Drawing 29). The concentrations of lead in these samples ranged from 5.5 to 8.7 mg/kg compared with 0.0 to 2.2 mg/kg for the reference locations (BK1161, BK1162, and BK1332) (Drawing 31). Significant accumulation of cadmium was found in organisms from three (3) locations in the wetlands of RASS 3 (13M1, 12N2, and 4R1) (Drawing 29), from three (3) locations in RASS 2 (12S1, 10R5, and 8S2) (Drawing 30), and from one (1) location in RASS 1 (7R1) (Drawing 30). The concentrations of cadmium in these samples ranged from 3.3 to 3.9 mg/kg,

compared with concentrations of 2.1 to 2.7 mg/kg for the reference locations (BK1161, BK1162, and BK1332) (Drawing 31). No significant bioaccumulation of lead or cadmium occurred, however, in organisms from locations in creeks draining into the Pier 4 slough or at the mouth of the Pier 4 slough and the Bay, indicating that lead and cadmium from these locations were not impacting the water quality of the Bay following the winter flood conditions.

Significant accumulation of zinc was found at one (1) location from Nichols Creek (13M1) (Drawing 29); both (2) locations in the wetlands of RASS 3 (12N2 and 4R1) (Drawing 29); at all four (4) locations in RASS 2 (12S1, 10R5, 8S2, and 6S1) (Drawing 30); at eight (8) of eleven (11) locations in RASS 1 (6R1, 7R1, 7T4, 10S3, 10T1, 12V1, 12W2, and 5W2) (Drawing 30); and at one (1) location in the creek west of RASS 1 (1242) (Drawing 31). The concentrations of zinc in these samples ranged from 183 to 403 mg/kg, compared with a range of 94 to 129 mg/kg for the reference locations (BK1161, BK1162, and BK1332) (Drawing 31).

No significant accumulation of zinc was found in the clams from locations in the creeks draining into the Pier 4 slough or at the mouth of the Pier 4 slough (1243, 1241, and 1244) (Drawing 31), indicating that flooding did not result in a significant input of bioavailable zinc to the Bay.

Significant accumulation of arsenic was found in clams from three (3) of four (4) locations in the wetlands of RASS 2 (12S1, 8S2, and 6S1) (Drawing 30) and at all eleven (11) locations from RASS 1 (6R1, 7R1, 7T4, 7T3, 10S3, 10T1, 12V1, 12W2, 5U1, 8W2, and 5W2) (Drawing 30). Clams at one (1) location in the creek west of RASS 1 also had significantly elevated arsenic (1247) (Drawing 31), as did those from the two (2) locations west of the Pier 4 slough (1241 and 1245) (Drawing 31). The concentrations of arsenic in the samples from these locations ranged from 2.2 to 3.0 mg/kg, compared with a range of 1.5 to 1.7 mg/kg for the reference locations (BK1161, BK1162, and BK1332) (Drawing 31). No significant accumulation of arsenic was found in clams from the locations where Nichols Creek drains into the Pier 4 slough or at the mouth of the Pier 4 slough and the Bay (1243 and 1244) (Drawing 31).

Summary of Surface Water Quality. An integrated view of the current status of surface water can be gained by examining the surface water quality and the clam biomonitoring data together.

The surface water data indicated that zinc, copper, and cadmium exceeded water quality criteria at several locations in RASS 3 (Drawing 25). In the clam data, zinc was significantly elevated in samples from the wetlands of RASS 3 in both the 1984 and the 1986 WES studies, confirming a serious problem with zinc water quality in RASS 3 (Drawing 29). Cadmium was significantly elevated in clam tissues from the 1986 WES study at these locations but at only one location in the 1984 study (Drawing 29), suggesting that the bioavailability of cadmium in the wetlands of RASS 3 may be dependent on flow conditions. Clams from RASS 3 were found to have significantly elevated copper at only one (1) location from the 1984 WES study (Drawing 29), suggesting limited copper bioavailability in the wetlands of RASS 3. Lead was significantly elevated in the tissues of clams from several locations in RASS 3 during both study periods. Thus, even though lead concentrations did not exceed the water quality criteria in RASS 3, bioavailable lead was significantly elevated in these wetlands. These discrepancies pointed out the importance of using both chemical and biological approaches when evaluating water quality.

In surface water samples taken in the 1984, 1985, and 1986 WES studies, the concentrations of zinc, cadmium, copper, lead, and arsenic exceeded water quality criteria at a number of locations in RASS 2 and RASS 1 (Drawing 26). Data from the clam bioassays for the three (3) locations in RASS 1 in the 198[illegible] study, however, indicated that the bioavailability of zinc, cadmium, and [illegible]enic was not significantly elevated in RASS 1 and RASS 2 (Drawing 30). In contrast, in the 1986 study the bioavailability of zinc, cadmium, and arsenic was significantly elevated at a number of locations in RASS 1 and RASS 2 (Drawing 30). These data suggest that zinc, cadmium, and arsenic may have more impact on the water quality of the wetlands in RASS 1 and RASS 2 after conditions of heavy flooding. Also, even though copper and lead exceeded the water quality criteria at some locations in the wetlands of RASS 1 and RASS 2 (Drawing 26), the lack of significantly elevated bioaccumulation in any of the clam samples (Drawing 30) suggested that these metals do not pose a significant water quality problem at these sites.

Taken together, these data indicate that several metals found in elevated concentrations in the surface waters of RASS 1, RASS 2, and RASS 3 are potentially bioavailable to aquatic organisms and may currently impair the water quality of these sites. However, the clam biomonitoring data do not indicate that these metals have adversely impacted the water quality of Suisun Bay, even after the flood conditions experienced in the winter of 1986. This observation is reinforced by the natural tendency of the clam bioaccumulation assay to overestimate the potential for bioaccumulation. However, it is difficult to draw precise conclusions about the status of water quality in this area because water quality data were not collected concurrently with the clam bioaccumulation studies.

On RASS 4, concentrations of lead, copper, and/or selenium were exceeded at 6 of 8 sampling locations for surface water. There were no claim assays performed to determine bioavailability, however.

3.1.3.2 Potential For Contaminant Migration. Analysis of water samples as well as the known physical chemistry of heavy metals indicates that the copper, zinc, lead, and cadmium on NWS Concord are most likely adsorbed on sediments or precipitated in relatively insoluble compounds (Huang et al. 1977). Though held in solid form, the contaminants may still be transported by surface water. Even relatively low water velocities could effectively move contaminated fine textured soil and sediment. Lee et al. (1986) discussed several different potential mechanisms by which contaminated soil and sediment are moved. These are discussed below.

Fluvial Transport. Any contamination suspended by Nichols Creek as it runs past the Chemical and Pigment Company would be transported to RASS 2 if the flow could reach the old SPTC culverts (section A-A plate 2.4). There are three ways that this might occur.

First, the water in Nichols Creek, as it flows west past the location of the old route through the culvert, could overtop the berm protecting the culvert. Any such overtopping of the berm in this area would flow directly to and through the culvert into RASS 2.

Second, if the right bank of the Creek (looking downstream) overflowed at a location about 400 to 500 feet or more upstream of the area near the culvert, the water would flow straight north to a depression (point C plate 2.4), and from there would flow into the ditch which runs along the south side of the tracks and then westward to the culvert.

Third, if water were backed up by the culvert under the unpaved road (section D-D plate 2.4) just north of the ATSF tracks, the water would overflow the road and flow north to the same depression (point C plate 2.4) noted in the second possibility above, and from there into the ditch to the culvert.

To study the peak discharge conditions which might lead to the first two possibilities outlined above, the water surface profiles of the creek under various discharge conditions were modeled. This was accomplished with HEC-2, a program developed by the US Army Engineer Hydrologic Engineering Center. Nine cross sections of the creek and overbank areas were used as input, along with peak flows for Nichols Creek and the tributary stream (Plate 2.4).

It was decided to begin by ignoring the possibility that the various culverts upstream (at the unpaved road and at the railroad tracks) might restrict the peak flows during a storm event, and to assume that the calculated peak discharge for the recurrence interval was flowing in the creek channel at the locations of interest. Peak discharges calculated by both the rational method and by the method of Waananen and Crippen (1977) were considered (Table 2.2).

If the calculated water surface elevation at section 8 rose above 10.0 feet, then overflow of the berm directly into the culvert (as outlined in possibility number one above) would occur. If the calculated water surface elevation at section 9 rose above 13.5 feet, then overflow of the right bank with flow to the depression (point C plate 2.4) and ditch would occur (as outlined in the second possibility above).

Discharges of 219 and 340 cubic feet/second (cfs) were used. These correspond to recurrence intervals of about 3 years and 10 years by the rational formula, and 10 years and 25 years by the Waananen and Crippen method. A discharge of 219 cfs did not produce overflow to the culvert by either of the possibilities

above. A discharge of 340 cfs, however did produce overflow to the culvert by overflowing the banks of the stream at section 9, that is, by overflowing as outlined in possibility number two above.

Finally, the third possibility outlined above was briefly considered. Here, the culvert pipe under the unpaved road could cause the water to back up behind the culvert until it overflows the road. If this happened, a significant part of the flow would continue downhill over the G-1 area and into the right overbank area to the depression (point C plate 2.4) and the ditch, rather than returning to the stream channel.

It appears that the culvert in the G-1 area may be inadequate, and that it is not able to pass the peak discharge of even a two-year event (Portland Cement Association 1964). Field observations indicate that the culvert appears to be fairly new, and it is not known how long this culvert configuration has been in position. However, based on field observations it appears that overflow into the right overbank area must occur fairly frequently.

Bank and surface erosion during flood flows on Nichols Creek. The HEC-2 results for discharges of 219 and 340 cfs suggest some inferences about potential erosion or deposition of sediment. Table 3.1 shows the calculated average velocities at the upper two cross sections that were used in the model. At section 8, Nichols Creek would spill into the old culverts; at section 9 (upstream from 8), it would flow into the depression and then into the ditch next to the SPTC tracks. The results at section 9 show that at the higher discharge, velocity in the channel is lower. This is because (in the model, at least) the flow is spread over a larger area. Maximum velocity along the bank at the outside of the channel bend would be greater than the average.

A calculation using the shield equation (Henderson 1966) indicates that at a flow of 219 cfs, the stream could theoretically entrain sediment particles as large as 0.6 inches diameter at section 8, and even larger particles at section 9. The actual erosion rate would depend on the degree of consolidation and density of vegetation.

Table 3.1
Velocity (ft/sec) in Nichols Creek above Southern Pacific Railroad tracks, based on HEC-2 results.

	219 cfs			340 cfs		
Sec. No.	Left Overbank	Channel	Right Overbank	Left Overbank	Channel	Right Overbank
8	.84	1.47	.90	1.01	1.64	1.10
9	---	3.54	---	.01	1.87	1.68

Before the old culvert was diverted (probably in the 1960's) suspended solid material was deposited west of RASS 2 north of the SPTC tracks. The results of computed water surface profiles indicated that flood flows from a 25-year storm would carry suspended solids over the creek bank through the culvert onto Parcel 572 in the RASS 2 area. Any contamination from ES (Parcels 579D and Parcel 576) and G-1 (Parcel 575) would therefore be released onto Parcel 572.

Velocities in Nichols Creek adjacent to the Chemical & Pigment Company (above the railroad tracks) were not calculated. Since the channel is narrower and steeper, velocity at this location should be greater than north of the tracks. The culverts under the tracks might pond the stream temporarily. The magnitude of this effect would depend largely on the amount of sediment deposited in the culverts, which for historic conditions is not ascertainable.

The storms and flood of February 12-21, 1986 provided a unique opportunity to determine the relationship between discharge and area flooded, and to observe pathways of sediment movement on the site. At NWS Concord, the storm sequence resulted in high runoff from Nichols Creek and flooding in low areas between the ATSF and SPTC tracks. High runoff from the Sacramento-San Joaquin Delta, combined with a high tide, caused flooding in the marsh north of the SPTC tracks. No rain fell at NWS Concord between the week of flooding and the observations. A peak flow estimate for Nichols Creek was based on physical measurements made on March 14, 1986.

Table 3.2 shows the daily rainfall amounts and recurrence intervals at Martinez. Although the one-day amount was not unusual, the 10-day amount was roughly a 15-year event.

Table 3.2

February 1986 Precipitation at Martinez Water Treatment Plant

Feb.	Precipitation Inches
12	0.13
13	0.62
14	0.58
15	1.62
16	0.42
17	1.54
18	2.13
19	1.98
20	0.89
21	0.12
Total	10.03

	Duration 1 day	2 day	3 day	10 day
Depth (inches)	2.13	4.11	5.65	10.03
Recurrence Interval (years)	<2	2-5	7	15

Flood elevations were measured at the bridge near Pier 4 (where a staff gage was placed in 1985) and at four points along the levee at the east edge of RASS 1. Staff gages in the marsh were either overtopped or did not show clear flood marks. At Pier 4, the flood crest was marked by a thin line of sediment deposited on a bridge wing wall, and a deposit of fine organic debris on a sandbar between the road bridge and railroad bridge. Elevations of both flood indicators were 5.03 feet NGVD. One higher flood mark (a sediment line) was present at 5.92 feet on a piling under the bridge, but has been washed away by rainfall on exposed pilings. The highest mark probably represents the December 1983 high tide/storm surge, and the 5.03 mark is the flood mark from February 1986. This probably corresponds with the high tide measurement of 6.05 feet NGVD by the Corps of Engineers at Antioch (14 miles upstream) around noon February 21, 1986.

Elevation of the wrack line along the Allied levee (site AA) was measured at 5.04, 5.19, 5.11, and 5.14 feet. These elevations agree well with the measurement at the slough mouth (Pier 4), and indicate that the entire marsh plain was flooded to an elevation of about 5.1 feet. This is somewhat less than a 10-year high tide (5.7 feet). Exposed sediment in the marsh next to the levee was mobilized. Disturbance of submerged sediment by wading stirred clouds of white material into suspension.

Runoff from Nichols Creek caused significant flooding in RASS 3. Flooded areas were identified in the field by 1) matted grass; 2) deposition of fine sediment; and 3) scour of sediment. Peak discharge was calculated by the slope-area method between Port Chicago Highway and the Chemical & Pigment Company plant. The flood peak was about 100 cfs, which has a recurrence interval of about seven years, by the method of Waananen and Crippen (1977). The peak discharge of Nichols Creek occurred two to three days before the flood tide in the marsh.

Nichols Creek overflowed its banks at the Chemical and Pigment Company, reaching the toe of the waste pond levee and flowing into a depression north of the waste pond, probably as a result of a backwater effect from culverts under the fence and under the railroad spur. It also overflowed into the depression upstream from and south of the ATSF tracks.

North of the ATSF tracks, the creek spread out and flowed in a shallow sheet, and some flowed to the cattail marsh. In two places, however, flow from Nichols Creek entered the ditch on the south side of the SPTC tracks. An eastern branch of the sheet flow infiltrated through soil macropores, and flowed through subsurface channels (or soil pipes) to the cutslope next to the SPTC tracks, where it emerged under pressure, causing considerable erosion damage to the cutslope. At the depression that marks the old stream channel, the creek also escaped into the ditch, enlarging the depression and exposing buried organic debris and a large concrete block.

Water in the ditch on the south side of the SPTC tracks flowed northwest to the old culverts that pass north beneath the tracks onto RASS 2. Some of the flow passed through these culverts and onto RASS 2, depositing new sediment

there, and probably reworking previously deposited sediment. Since the culverts are partially blocked, they could not handle all of the flow in the ditch, and some water continued along the south site of the tracks, rejoining the flow from Nichols Creek in the cattail marsh.

The physical evidence from the February 1986 flood indicates that a flood of 100 cfs enters the SPTC ditch at two areas, carrying sediment from Nichols Creek to the Kiln Site. In other words, overflow to RASS 2 occurs more frequently than previously thought.

Direct observations following the February 1986 storm indicated the major pathways by which Nichols Creek can move sediment and redeposit it in the wetland. Adjacent to the Chemical Pigment Company, the stream scoured sediment from its banks. Between the SN and the ATSF rights-of-way, the stream overflowed to depressions on both sides of the stream. Sediment mobilized from upstream could thus have been deposited on the railroad rights-of-way. Below the ATSF tracks, the stream again overflowed its banks, in two places (see discussion above). This overflow carried sediment from Nichols Creek into the ditch on the south side of the SPTL tracks. Water that flowed through the old culverts beneath the SP track carried sediment from the ditch to the debris fan next to the kiln site. During the high tide that followed, some of this sediment could have been remobilized and carried to the wetland or to the Bay. To summarize, the possible sediment source areas during the February 1986 flood include: Parcel 579D-N, 579D-CP, 579D-SN, 576-SN, 576-N, 576-SF, 575-SF, 575-N, 575-SP, 574-SP, 572-SP, 573-SP, and 572-N. Possible sediment deposition areas include 579D-SN, 576-SN, 576-N, 576-SF, 575-SF, 575-N, 575-SP, 574-SP, 574-N, 573-N, 572-SP, 572-SF, 572-N, and 571-N.

Tidal Scouring. Once contaminated sediments have been deposited in the marsh, they are remobilized by tidal action. Sediments deposited in slough channels where velocities are higher can scour fairly rapidly and redistribute into the tidal drainage system, eventually moving out to Suisun Bay. Sediments and contaminants deposited on the marsh plain tend to be less mobile because of lower velocities and lower frequency of inundation. The tidal frequency analysis indicates that a tide that would be expected on the average 1.3 times per year is capable of distributing fine sediment over much of the marsh plain.

The actual rate of spread of contaminants by tidal action depends on the interaction of several variables that are difficult to quantify. These include the particle size and density of contaminated sediment, the density of vegetation growing on contaminated areas of the marsh, and the magnitude and frequency of wind-generated waves during high tides. Regardless of the complexity of the mechanisms and variables involved, however, the distribution of arsenic and heavy metals in the marsh (Lee et al. 1986 and 1988) corresponds to a large extent with the tidal drainage network.

Wave Action - Erosion of the Marsh Plain. Large amounts of contaminated sediment are mobilized by wave action during extreme tides. Extreme tides are caused by the superimposition of storm surges on normal high tides. These occur during the winter months and can be accompanied by local storm conditions. For example, a 10-year high tide will flood the marsh plain to depths of about 2-1/2 ft. With the long fetch of Suisun Bay to the west, considerable wave action is generated that erodes surface sediments and redistributes such sediments on the marsh and into Suisun Bay. The erosion is limited by the presence of vegetation and the degree of cohesion of the sediment.

Wave Action - Erosion of the Bayward Margin. Intense wave action, even at normal high tides, causes erosion of the bayward margin of the marsh plain. In the past, the edge of the marsh has experienced both erosion and accretion. However, in the future it is more likely to undergo additional erosion than accretion. This is due to the reduction of sediment supply to Suisun Bay over the last 50 years caused by dam construction, the dissipation of the "wave" of sediment carried into the system due to hydraulic mining in the nineteenth century, and the sea level rise. Sea level rise is now predicted to accelerate due to global climatic changes (USEPA 1983a). This would cause substantial erosion of the shoreline, distributing deposited sediments into Suisun Bay.

3.1.4 Ground Water.

3.1.4.1 Assessment of Current Ground Water Conditions. To date, extensive investigations of the groundwater have not been conducted. One (1) rather

abbreviated study has been conducted which directly addresses the groundwater contamination issue. In addition, two (2) studies that indirectly address the groundwater issue have been conducted.

Groundwater Investigations. In April and May of 1987, the Navy installed three groundwater monitoring wells (WES-1, WES-2, and WES-3) on the north side of the bare ground and rubble pile in the RASS 2 area (Drawing 40). Monitoring wells were less than 200 feet apart and about 100 feet from the rubble pile. The wells were located to intersect the most probable direction of groundwater flow from the contaminated area. The wells were installed with a 6-inch hollow stem auger. Since the primary contaminants of concern were the metals, PVC screens and casings were used. Well WES-1 was drilled to a depth of 20 feet. Wells WES-2 and WES-3 were drilled to a depth of 15 feet because the shallow aquifer was fully penetrated at this depth.

The three wells located in the RASS 2 area, and a background well (BG) located approximately 1600 feet south of the RASS 2 area were sampled. The location of the background well (BG) is also shown on Drawing 40.

Samples were collected on 16 May 1987 and 18 August 1987 and analyzed for total and dissolved zinc, copper, cadmium, arsenic, lead, and selenium. The data collected from these efforts are presented on Drawing 40. Results from the first set of samples were inconclusive because of apparently high background levels of lead, indications that the water used to clean the sampling equipment had become contaminated, and unexplained anomalies between the values reported for the filtered and unfiltered samples. Taken at face value, however, these data indicated the following. Cadmium concentrations in filtered groundwater exceeded the maximum contaminant level (MCL) (0.01 mg/l) in wells WES-1 and WES-3. Lead concentrations in filtered groundwater exceeded the MCL (0.05 mg/l) in wells WES-1, WES-2, and WES-3, as well as the background well.

The second round of samples produced results that appear to be more consistent and reasonable analytically. Cadmium concentrations in filtered groundwater exceeded the MCL (0.01 mg/l) in wells WES-1 and WES-2. Lead concentrations in filtered groundwater exceeded the MCL (0.05 mg/l) in well WES-1. Selenium

concentration in filtered groundwater exceeded the MCL (0.01 mg/l) in wells WES-1, WES-2, and WES-3. Arsenic concentrations in filtered groundwater exceeded the MCL (0.05 mg/l) in well WES-1.

Both Chemical and Pigment Company and Allied Corporation have conducted brief investigations of the potential for groundwater contamination.

In a study for Chemical and Pigment Company, Kleinfelder and Associates (1983) installed and sampled three (3) monitoring wells for zinc and copper (M1, M2, and M3). Kleinfelder (1983) found that the direction of water movement is toward the northeast. All samples were within drinking water standards for the two (2) metals. However, review of these data revealed some apparent anomalies. For example, an outside laboratory reported results five (5) times higher than the results obtained by Chemical and Pigment's internal laboratory. In addition, filtered samples were reported to have a higher concentration of metals than the unfiltered samples.

During the period from November 1985 through February 1987, additional samples were collected and analyzed. Data from this sampling effort are presented in Drawing 40. Concentrations of zinc and copper continued to be below the drinking water standards. Data are not available, however, for lead, arsenic, cadmium, or selenium for the monitoring wells or the supply well.

Allied Corporation conducted a groundwater investigation on the Bay Point Works during January and February 1977. This investigation included sampling and analysis from approximately seven (7) drill holes and twenty-four (24) driven well points (Drawing 39). Samples were analyzed for pH, total dissolved solids (TDS), aluminum, fluoride, zinc, cadmium, lead, arsenic, and iron. Many of the samples exceeded standards for drinking water (Drawing 39). No information is available on quality assurance/quality control (QA/QC) of sampling and analytical techniques or well construction methods used during this study.

Pore Water Study. A 1985 study (Brown and Caldwell) attempted to measure potential migration of contamination through the soil pore water. Brown and Caldwell (1985) installed soil water extractors (lysimeters) at five locations

in the contaminated area in 1985. Samples of soil pore water were collected from two depths (12 and 24 inches) and analyzed for arsenic, selenium, and heavy metals. Data collected during this study are presented on Drawings 40 and 41. In the KS area of Parcel 572 on NWS Concord, a sample from 24 inches depth exceeded EPA criteria for drinking water by a factor of 80 for cadmium and by a factor of 28 for zinc. A sample collected from a depth of 12 inches in the eastern portion of RASS 1 (IGU1) exceeded the criterion for arsenic by a factor of 3. The collection of water by the soil pore water extractors was not very successful, and only a few samples were analyzed.

Soil Contamination Studies. In addition to the pore water and groundwater investigations, soil contamination data have been reviewed to determine the depth of contaminant migration. These studies have been described in detail above. In general, contamination is limited to the top 12 inches of the soils. Samples at depth have indicated the rapid attenuation of metals with soil depth. These data support the theory that groundwater contamination from these surficial deposits is a remote possibility.

3.1.4.2 Potential for Contaminant Migration. The geology and types of contamination found on Parcels 572, 573, 574, 575, 576, 579D, and 581 on NWS Concord combine to limit the potential for migration of contaminants into the underlying groundwater. The potential for groundwater contamination depends not only on the degree to which the metals are adsorbed or precipitated, but also on the permeability of the soil overlying the water table. A study by Harding-Lawson Associates (1977) found that although the peat in the undisturbed marsh is fairly permeable, the marsh soils are underlain by a relatively impermeable layer of stiff sandy silt at a depth of 15 to 20 feet. Harding-Lawson (1977) and the State of California Regional Water Quality Control Board (1977) concluded that the presence of this relatively impermeable layer makes vertical migration of contamination into the underlying usable groundwater unlikely.

However, it was also concluded that lateral movement of contaminants within the permeable peat near the surface was possible. A plan was implemented to construct a barrier of reduced permeability around the north nd west perimeter of the Bay Point Works by compressing the peat with a surcharge created

by the construction of a dike. Subsequent testing revealed mixed results with permeabilities near 10^{-6} cm/sec being reported (Harding-Lawson 1977).

3.1.5 Air.

3.1.5.1 Assessment of Current Air Conditions. To date, a quantitative assessment of the air pathway has not been conducted.

3.1.5.2 Potential for Contaminant Migration. The high energy wind environment on NWS Concord results in the potential transport of contaminated soils and dry sediments by wind action. Numerous barren areas located in the study area are highly susceptible to this surface wind activity and movement of contaminants via fugitive dust is likely. Although no quantitative measurement of the problem has been made, qualitative observations indicate that during dry periods, fugitive dust is generated and released from the individual RASS's. There is potential for affecting human, plant, and animal life on uncontaminated areas of NWS Concord as well as on adjacent properties. Personnel working at NWS Concord and for the private companies adjacent to the study area are potentially exposed to the risk of contamination from airborne soil particles.

Table 3.3 shows the percentage frequency of wind direction and speed at the Pittsburg power plant located on the shore line a few miles east of the site. Velocity measurements were taken 33 ft above the ground, and wind speed at the soil surface would be less. The numbers indicate that 30.2 percent of the time, the wind blows from the southeast to west northwest at 13 mph or more, and that wind speeds exceeding 25 mph occur 0.5 percent of the time, or about 44 hours per year.

This process is limited by the presence of sheltering vegetation, the cohesion of the sediment, and wetting due to high water table. Frequent tidal inundation will tend to stabilize particles, consequently the drier, higher elevation areas such as portions of RASS 2 will be more susceptible to wind erosion.

Table 3.3
Percentage Frequency of Wind Direction and Speed at Pittsburg Power Plant
(from California DWR, 1978)

SURFACE WINDS

PERCENTAGE FREQUENCY OF WIND DIRECTION AND SPEED (FROM HOURLY OBSERVATIONS)

STATION: ______ STATION NAME: Pittsburg Power Plant, CA YEARS: December 1970 thru November 1973 MONTH: ALL

CLASS: ALL WEATHER HOURS (L.S.T.): ALL

LOCATION: 38°03', 121°54', 20'

HEIGHT ABOVE GROUND: 33 feet

SPEED MPH / DIR.	1-3	4-7	8-12	13-18	19-24	25-33	34-44					%	MEAN WIND SPEED
N	0.8	0.7	0.5	0.6	0.3	0.2	0.0					3.1	10.1
NNE	0.5	0.4	0.2	0.1	0.0	0.0						1.2	6.0
NE	0.7	0.7	0.1	0.0	0.0							1.6	4.8
ENE	0.7	1.3	0.3	0.0	0.0							2.4	4.8
E	1.5	2.7	0.9	0.2	0.0	0.0						5.3	5.5
ESE	1.3	1.7	1.0	0.3	0.1	0.0						4.5	6.5
SE	1.4	0.8	0.4	0.2	0.0							2.8	5.2
SSE	0.9	0.4	0.1	0.1	0.0							1.6	4.4
S	1.2	0.4	0.3	0.1	0.1	0.0						2.0	5.1
SSW	1.0	0.6	0.7	0.5	0.2	0.0	0.0					3.0	7.9
SW	1.1	1.8	3.9	4.4	0.7	0.1	0.0					11.9	11.3
WSW	0.9	2.6	7.4	8.2	1.9	0.0						21.1	12.2
W	1.0	3.0	7.6	8.9	1.8	0.0						22.3	12.1
WNW	0.7	1.8	3.3	3.8	0.4	0.0						10.0	11.0
NW	0.7	1.2	0.9	0.8	0.1	0.0						3.8	8.5
NNW	0.7	0.5	0.3	0.4	0.4	0.1						2.4	10.1
CALM												0.9	10.1
0.9	15.2	20.6	28.0	28.6	6.1	0.5	0.0					99.9	

DATA FROM Pacific Gas and Electric Company

TOTAL NUMBER OF OBSERVATIONS 23,5[illegible]8

3.1.6 Summary.

The movement of contaminants through air, soil, water, and biota involves complex chemical and biological interactions. Consequently, biological testing is necessary to assess the potential for contamination to move from the soil into the biota of the ecosystem. Certain bioassay procedures have been developed to identify and quantify the potential for contaminant mobility into food chains. The primary point of emphasis is that contaminants exert their greatest influence and cause the most biological damage onsite, but also may be mobilized and act at some distance from the source.

On site contamination within each area has been documented in the RI (Lee et al. 1986). In addition, migration of contaminants from each area is occurring. The primary exposure pathways appear to be surface water and biological uptake and accumulation. Secondary pathways appear to be the air and direct contact. The groundwater pathway appears to be of minor importance; however, as requested by the RWQCB an extensive ground water investigation is currently being conducted.

3.2 Environmental Protection Goals and Selected Action Levels

3.2.1 General Environmental Goals.

Large quantities of hazardous substances (primarily heavy metals) were deposited at various areas on NWS Concord. The Remedial Investigation (Lee et al. 1986) and previous studies (Ecology and Environment 1983; Anderson Geotechnical 1984) have documented the distribution and migration of these hazardous substances. Contaminants have been found to exceed various criteria and levels at reference areas (Lee et al. 1986) in surface soils. It is reasonable to conclude that these contaminated areas and the resultant migration of hazardous substances directly resulted from the improper handling of hazardous substances.

An evaluation of the contaminant types and concentrations found in the contaminated areas included in this feasibility study indicates that the primary contaminants of concern are the heavy metals, including lead, cadmium, copper,

and zinc, as well as arsenic and selenium. Based on a variety of existing standards (Lee et al. 1986, 1985), the contamination has degraded surface soils and is a present and/or potential danger to human health and the environment, including wildlife and vegetative populations colonizing and using the sites or areas adjacent to the contamination.

Under a no-response scenario, the primary existing and potential dangers to the public health or welfare or the environment are:

a. Migration of sediments contaminated with arsenic, cadmium, copper, lead, selenium, and/or zinc via surface water transport.

b. Biological uptake and accumulation of arsenic, cadmium, copper, lead, selenium, and/or zinc.

c. Direct contact with soils contaminated with arsenic, cadmium, copper, lead, selenium, and/or zinc.

d. Migration of dust contaminated with arsenic, cadmium, lead, selenium, and/or zinc via the air pathway to uncontaminated areas (wind-borne fugitive dust).

The goals that Section 121(b) of the Comprehensive Environmental Response, Compensation and Liability Act, as amended, requires that the Navy attain in selecting a remedial action are protection of human health and the environment; cost effectiveness; and utilization of permanent solutions and alternative treatment technologies to the maximum extent practicable. Section 121(a) of CERCLA, as amended, requires that the Navy select a remedial action which is in accordance with Section 121 of CERCLA, as amended, and to the extent practicable, with the National Contingency Plan and which provides for cost-effective response. Section 121(d) of CERCLA, as amended, requires that the Navy select a remedial action which, at the completion of the remedial action, attains a level or standard of control (with respect to any hazardous substances that will remain on site) which will at least attain:

a. Any legally applicable or relevant and appropriate standards, requirements, criteria, or limitations (under the circumstances of the release or threatened release of hazardous substances) under any Federal environmental law;

b. Any legally applicable or relevant and appropriate promulgated standards, requirements, criteria, or limitations (under the circumstances of the release or threatened release of hazardous substances) under any State environmental or facility siting law (which are more stringent than any Federal standards, requirements, criteria, or limitations and which have been identified to the Navy by the State in a timely manner. Section 121(d) of CERCLA, as amended, however, provides that the Navy may select a remedial action meeting the requirements of Section 121(d) of CERCLA, as amended, which does not attain a level or standard of control at least equivalent to an applicable or relevant and appropriate standard, requirement, criteria, or limitation as required by Section 121(d) of CERCLA, as amended, if the Navy finds that one or more of the following conditions exists;

(1) The remedial action selected is only part of a total remedial action that will attain such level or standard of control when completed;

(2) Compliance with such standards, requirements, criteria, or limitations will result in greater risk to human health and the environment than alternative options;

(3) Compliance with such standards, requirements, criteria, or limitations is technically impracticable from an engineering perspective;

(4) The remedial action selected will attain a standard of performance which is equivalent to that required under the otherwise applicable standards, requirements, criteria, or limitations through use of another approach;

(5) With respect to State standards, requirements, criteria, or limitations, the State has not consistently applied (or demonstrated the intention to consistently apply) the standards, requirements, criteria, or limitation in similar circumstances at other remedial actions within the State.

The principal impact to the environment at NWS Concord is the contamination of wildlife habitats in the vicinity of the site and continued migration of hazardous substances into the environment surrounding the contaminated areas at NWS Concord. Surface soil contamination is of primary concern because of the following potential endangerment to receptors:

a. Existing and future human users of the contaminated areas through direct contact;

b. Existing and future wildlife users coming into direct contact with the contaminated areas;

c. Vegetation coming into direct contact with contaminated areas;

d. Wildlife exposed to hazardous substances via food chain contamination; and

e. Human, wildlife, and vegetation exposed to contamination resulting from the continued migration of contaminants into the environment.

Secondary concerns include:

a. Exposure of humans in the immediate vicinity of the contaminated areas; and

b. Release of hazardous substances via a catastrophic event such as an earthquake or flood.

The general environmental goal for the remediation which the Navy established calls for preventing or minimizing the release of hazardous substances causing substantial danger to present or future human health or the environment, using cost effective measures, without adversely impacting important wildlife habitat in the long term.

3.2.2 Specific Environmental Protection Goals

Three primary specific remedial objectives have been established for the remedial program. These are:

a. Prevent biota from contacting contaminated soils that would threaten them;

b. Prevent resuspension in surface water and air and redistribution of the contaminated sediments and soils that would threaten the area flora and fauna;

c. Minimize disturbance to the wetlands consistent with long term protection of flora and fauna; and

d. Prevent migration of contaminants into the ground water.

Remedial alternatives which may achieve these objectives and are suitable for initial screening were developed by a three-step process. Response criteria were first established to evaluate the acceptability of environmental and public health impacts and anticipated performance of the alternative. This step establishes the applicable or relevant and appropriate requirements and other criteria as appropriate to define performance requirements and potential human risks associated with the remedial action. Next, potentially applicable technologies identified in Section 4.0 were used to develop comprehensive site remedial alternatives on the basis of operation and performance compatibility, and use of acceptable engineering practice. Finally, the alternatives were evaluated on the basis of the established criteria.

3.3 Identification of Potentially Applicable or Relevant and Appropriate Requirements

On 17 October 1986, the President signed into law the Superfund Amendments and Reauthorization Act of 1986 (SARA), amending and reauthorizing the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). SARA modified the requirements for the selection of a remedial action for the

release, and/or threatened release, of hazardous substances on Parcels 571, 572, 573, 574, 575, 576, 579D, and 581 on the NWS Concord.

On 9 July 1987, the Environmental Protection Agency issued Interim Guidance on Compliance with Applicable or Relevant and Appropriate Requirements (ARAR's) (USEPA 1987a). "Applicable requirements" are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations established under any Federal environmental law or promulgated under any State environmental or facility siting law which specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance of a CERCLA site. "Relevant and appropriate requirements" are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under any Federal environmental law or promulgated under any State environmental or facility siting law which, while not applicable to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstances at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site.

The interim guidelines distinguish three (3) different types of ARAR's:

a. Locational requirements, which set restrictions on activities or limits on contaminant levels depending on the characteristics of a site or its immediate environs.

b. Performance, design, or other action-specific requirements, which set controls or restrictions on particular kinds of activities related to management of hazardous substances, pollutants, or contaminants.

c. Ambient or chemical-specific requirements, which set health or risk-based concentration limits in various environmental media for specific hazardous substances, pollutants, or contaminants.

As part of the initial feasibility study process (Cullinane et al. 1986), the Navy identified Federal statutes, regulations, and other authorities with

which the Navy may have to comply in responding to the release or the threat of the release of hazardous substances on Parcels 571, 572, 573, 574, 575, 576, 579D, and 581 on NWS Concord. These included the following:

a. The Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S.C. 9601 et seq.

b. The Resource Conservation and Recovery Act, 42 U.S.C. 9601 et. seq.

c. The Federal Water Pollution Control Act, 33 U.S.C. 1251 et. seq.

d. The River and Harbor Act, 33 U.S.C. 401 et. seq.

e. The Endangered Species Act, 16 U.S.C. 1531 et. seq.

f. The Migratory Bird Conservation Act, 16 U.S.C. 703 et. seq.

g. The Safe Drinking Water Act, 42 USC 300 f et. seq.

h. The National Oil and Hazardous Substances Contingency Plan, 40 C.F.R. Part 300.

i. Solid Waste, 40 C.F.R Subchapter I.

j. Designation of Hazardous Substances, 40 C.F.R. Part 116.

k. Determination of Reportable Quantities for Hazardous Substances, 40 C.F.R. Part 117.

l. Regulatory Programs of the Corps of Engineers, 33 C.F.R. Parts 320-330.

m. Section 404(b)(i) Guidelines for Specification of Disposal Sites for Dredged or Fill Material, 40 C.F.R. Part 230.

n. Endangered and Threatened Wildlife and Plants, 50 C.F.R. Part 17.

o. Response to Environmental Damage, Executive Order 12316, 46 Fed. Reg. 42237 (14 August 1981).

p. Protection of Wetlands, Executive Order 11990, 42 Fed. Reg. 26961 (25 May 1977).

q. Memorandum of Understanding Between the Department of Defense and the Environmental Protection Agency for the Implementation of P.L. 96-510, The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (12 August 1983).

r. Memorandum of Understanding Between the Department of the Navy and the U. S. Fish and Wildlife Service Relating to Designation of Wetland Preserve on the Naval Weapons Station, Concord, California (1 February 1984).

s. Region IV Oil and Hazardous Substance Pollution Contingency Plan.

t. Memorandum from Secretary of Defense (2 November 1981).

u. Navy Assessment and Control of Installation Pollutants Program. As part of the initial feasibility study process (Cullinane et al. 1986), the Navy also identified state statutes and regulations which may provide guidance to the Navy in responding to the release or the threat of release of the hazardous substances on Parcels 571, 572, 573, 574, 575, 576, 579D, and 581 on NWS Concord. These include the following.

a. The California Solid Waste Management, Resource Recovery and Recycling Act of 1972, California Government Code, Title 7.3, Chapter 1, Section 66700, et. seq.

b. The California Hazardous Waste Control Act, California Health and Safety Code, Division 20, Chapter 6.5, Section 25100, et. seq.

c. The California Underground Storage of Hazardous Substances Act, California Health and Safety Code, Chapter 6.7, Section 25280 et. seq.

d. The California Porter - Cologne Water Quality Act, California Water Code, Division 7, Section 13000 et. seq.

e. The California Coastal Act, California Public Resources Code, Division 20, Section 30000 et. seq.

f. Migratory Birds, Article 3, Sections 355-357, Fish and Game Commission, California Fish and Game Code, Division 1, Section 101 et. seq.

g. Keene-Nejedly California Wetlands Preservation Act, California Public Resources Code, Chapter 7, Section 5810 et. seq.

h. San Francisco Bay Conservation and Development Commission, California Government Code, Title 7.2, Section 66600, et. seq.

i. Suisun Marsh Preservation Act of 1977, Public Resources Code, Division 18, Chapter 3, Section 29200 et. seq.

j. Endangered Species, Chapter 1.5, Section 2050 et. seq., California Fish and Game Commission, California Fish and Game Code, Div. 3, Section 2000 et. seq.

k. California Hazardous Waste Management Regulations, California Administrative Code 1 - Title 22, Social Security, Division 4, Environmental Health, Chapter 30 Minimum Standards for Management of Hazardous, and Extremely Hazardous Wastes.

l. California Water Regulations, California Administrative Code, Title 23, Waters, Chapter 3 - State Water Resources Control Board, Sections 1050 through 2836.

In 1987, the EPA (1987b) identified a number of potentially applicable or relevant and appropriate requirements for site cleanup. These are listed in Table 3.4. In 1987, the EPA (1987b) also developed a list of other federal criteria, advisories, guidance, and state standards to be considered. These are presented in Table 3.5.

In response to the enactment of SARA in 1986 and as part of the feasibility study process, the Navy requested the Environmental Protection Agency and the State of California Department of Health Services, Regional Water Quality Control Board, Bay Area A in Quality Management District and Department of Fish and Game to identify any requirements, standards, criteria, and/or limitations which such agencies believe are applicable or relevant and appropriate to the Navy's response to the release or the threat of release of hazardous substances on Parcels 571, 572, 573, 574, 575, 576, 579D, and 581 on NWS Concord. A summary of responses received to date is provided below.

The U.S. EPA, Region 9 provided general guidance (USEPA 1987c) on ARAR identification. Specific guidance was limited to a recitation of ARARs identified in Section 121(d) of SARA which cites federal environmental laws that may be considered ARARs including but not limited to the Toxic Substances Control Act, the Safe Drinking Water Act, the Clean Water Act, the Clean Air Act, the Marine Protection, Research and Sanctuaries Act, the Solid Waste Disposal Act, and the National Oil and Hazardous Substances Pollution Contingency Plan.

The California Department of Fish and Game (California Department of Fish and Game 1987) identified the California Fish and Game Code, Section 5650 a-f, which prohibits the discharge of materials which are deleterious to fish, plant life, or bird life, as a potential ARAR. Furthermore, the deposition of such materials or allowing such materials to remain in place where they can enter waters of the state is likewise prohibited (California Department of Fish and Game 1987). The Fish and Wildlife Coordination Act was also identified as a potential ARAR. General guidance was also provided as follows.

Table 3.4

Potentially Applicable or Relevant and Appropriate Requirements*

1. Office of Solid Waste

- o Resource Conservation and Recovery Act of 1976 (42 U.S.C. 6901)

  a. 40 CFR Part 264, for permitted facilities, and 40 CFR Part 265, for interim status facilities.

  -- Ground-Water Protection (40 CFR 264.90-264.101)
  -- Ground-Water Monitoring (40 CFR 264.90-265.94)
  -- Closure and Post-Closure (40 CFR 264.110-264.120, 265.110-265.120)
  -- Containers (40 CFR 264.170-264.178, 265.170-265.177)
  -- Tanks (40 CFR 264.190-264.200, 265.190-265.199)
  -- Surface Impoundments (40 CFR 264.220-264.249, 265.220-265.230)
  -- Waste Piles (40 CFR 264.250-264.269, 265.250-265.258)
  -- Land Treatment (40 CFR 264.270-264.299, 275.270-265.282)
  -- Landfills (40 CFR 264.300-264.339, 265.300-265.316)
  -- Incinerators (40 CFR 264.340-264.999, 265.340-265.369)
  -- Dioxin-Containing Wastes (50 FR 1978). Includes the final rule for the listing of dioxin-containing waste.

  b. Open Dump Criteria - pursuant to RCRA Subtitle D: criteria for classification of solid waste disposal facilities (40 CFR Part 257). Note: Only relevant to nonhazardous wastes.

2. Office of Water

- o The Safe Drinking Water Act (42 U.S.C. 300f)

  a. Maximum Contaminant Levels (17 chemicals, turbidity, and microbiological contamination) (for drinking water or human consumption) (40 CFR 141.11-141.16) and Maximum Contaminant Level Goals (SDWA 1421(b)(3).

  b. Underground Injection Control Regulations (40 CFR Parts 144, 145, 146, 147).

- o Clean Water Act (33 U.S.C. 1251)

(Continued)

* This is the list of potentially applicable or relevant and appropriate requirements found in the October 2, 1985, Compliance Policy with additions. As additional requirements are promulgated, they may also be considered potentially applicable or relevant and appropriate and added to this list.

Table 3.4 (Continued)

Requirements established pursuant to sections 301 (effluent limitations), 302 (effluent limitations), 303 (water quality standards, including State water quality standards), 306 (national performance standards), 307 (toxic and pretreatment standards, including Federal pretreatment standards for discharge into publicly owned treatment works), 402 (national pollutant discharge elimination system), 403 (ocean discharge criteria), and 404 (dredged or fill material) of the Clean Water Act, (33 CFR Part 323, 40 CFR Parts 122, 123, 125, 131, 230, 231, 233, 400-469). See especially Federal Water Quality Criteria (WQC). 45 FR 79318 (Nov. 28, 1980) and 49 FR 5831 (February 15, 1984).

- o Marine Protection, Research, and Sanctuaries Act (33 U.S.C. 1401)

  Incineration at sea requirements (40 CFR Parts 220-225, 227, 228). See also 40 CFR 125.120-125.124.

3. Office of Pesticides and Toxic Substances

- o Toxic Substances Control Act (15 U.S.C. 2601)

  a. PCB Requirements Generally: 40 CFR Part 761; Manufacturing Processing, Distribution in Commerce, and Use of PCBs and PCB Items (40 CFR 761.20-761.30); Marking of PCBs and PCB Items (40 CFR 761.40-761.45); Storage and Disposal (40 CFR 761.7=60-761.79); Records and Reports (40 CFR 761.180-761.185). See also 40 CFR 129.105, 750.

  b. Disposal of Waste Material Containing TCDD (40 CFR 775.180-775.197).

4. Office of External Affairs

- o Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material (40 CFR Part 230).

- o Section 404(c) Procedures for Denial or Restriction of Disposal Site for Dredged Material (40 CFR Part 231

5. Office of Air and Radiation

- o The Uranium Mill Tailings Radiation Control Act of 1978 (42 U.S.C. 2022)

  Uranium mill tailing rules - Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings (40 CFR Part 192).

- o Clean Air Act (42 U.S.C. 7401)

  a. National Ambient Air Quality Standards for total suspended particulates (40 CFR 50.6-50.7).

(Continued)

(Sheet 2 of 4)

Table 3.4 (Continued)

b. National Ambient Air Quality Standards for ozone (40 CFR 50.9).

c. Standards for Protection Against Radiation - high and low level radioactive waste rule (10 CFR Part 20). See also 10 CFR Parts 10, 40, 60, 61, 72, 960, 961.

d. National Emissions Standards for Hazardous Air pollutants for Asbestos (40 CFR 61.140-61.156). See also 40 CFR Parts 472.110-427.116, 763.

e. National Emissions Radionuclides (40 CFR Part 61, 10 CFR 20.101-20.108).

6. Other Federal Requirements

- OSHA requirements for workers engaged in response or other activities.
- Occupational Safety and Health Act of 1970 (29 U.S.C. 651).

  a. Occupational Safety and Health Standards (General Industry Standards) (29 CFR Part 1910).

  b. The Safety and Health Standards for Federal Service Contracts (29 CFR Part 1926).

  c. The Shipyard and Longshore Standards (29 CFR Part 1915, 1918).

  d. Recordkeeping, reporting, and related regulations (29 CFR Part 1904).
- Historic Sites, Buildings, and Antiquities Act (16 U.S.C. 461).
- National Historic Preservation Act, 16 U.S.C. 470.
- Department of Transportation Rules for the Transportation of Hazardous Materials, 49 CFR Part 107, 171.1-172.558.
- Regulation of activities in or affecting waters of the United States pursuant to 33 CFR Parts 320-329.
- Endangered Species Act of 1973, 16 U.S.C. 1531. (Generally, 50 CFR Parts 81, 225, 402).
- Wild and Scenic Rivers Act, 16 U.S.C. 1271.
- Fish and Wildlife Coordination Act, 16 U.S.C. 661 note.

(Continued)

(Sheet 3 of 4)

Table 3.4 (Concluded)

- o Fish and Wildlife Improvement Act of 1978, and Fish and Wildlife Act of 1956, 16 U.S.C. 742a note.
- o Fish and Wildlife Conservation Act of 1980, 16 U.S.C. 2901. (Generally, 50 CFR Part 83).
- o Coastal Zone Management Act of 1972, 16 U.S.C. 1451. (Generally, 15 CFR Part 930 and 15 CFR 923.45 for Air and Water Pollution Control Requirements).

7. <u>More Stringent, Promulgated State Standrads</u>

- o Potential State ARAR's are too numerous to list; they are identified by individual States on a site-by-site basis.
- o State requirements on disposal and transportation of radioactive wastes.

(Sheet 4 of 4)

Table 3.5

Other Federal Criteria, Advisories, Guidance, and State Standards to be Considered*

1. Federal Criteria, Advisories and Procedures

- o Health Effects Assessments (HEAs) (Proposed HEAs).
- o Recommended Maximum Concentration Limits (RMCLs) Now Maximum Contaminant Level Goals (MCLGs).
- o Federal Water Quality Criteria (1976, 1980, 1984).
- o Pesticide and Food additive tolerances and action levels.

  Note: Germane portions of tolerances and action levels may pertain and should therefore be considered in certain situations.
- o Waste load allocation procedures, EPA Office of Water.
- o Federal Sole Source aquifer requirements.
- o Public health criteria on which the decision to list pollutants as hazardous under Section 112 of the Clean Air Act was based.
- o Guidelines for Ground-Water Classification Under the EPA Ground-Water Protection Strategy.
- o New source performance standards for storage vessels for petroleum liquids.
- o TSCA chemical advisories (2 or 3 issued to date).
- o Advisories issued by FWS and NMFS under the Fish and Wildlife Coordination Act.
- o Executive Orders related to floodplains (11988) and wetlands (11990) as implemented by EPA's August 6, 1985, Policy on Floodplains and Wetlands Assessments for CERCLA Actions.
- o TSCA Compliance Program Policy.
- o OSHA health and safety standards that may be used to protect public health (non-workplace).
- o Health Advisories, EPA Office of Water.

* This list duplicates the list of other Federal criteria, advisories, guidance, and State standards to be considered in the October 5, 1985, Compliance Policy. As additional or revised criteria, advisories, guidance, or standards are issued, they should be added to this list and also considered.

(Sheet 1 of 5)

Table 3.5 (Continued)

2. <u>State Criteria, Advisories, and Procedures</u>

- o State approval of water supply system additions or developments.
- o State ground water withdrawal approvals.
- o Requirements of authorized (Subtitle C of RCRA) State hazardous waste programs.
- o State implementation plans and delegated programs under the Clean Air Act.
- o All other State requirements, not delegated through EPA authority.
- o <u>Approved State NPDES programs under the Clean Water Act</u>.
- o <u>Approved State UIC programs under the Safe Drinking Water Act</u>.

Note: Many other State and local requirements could be pertinent. Forthcoming guidance will include a more comprehensive list.

3. <u>USEPA RCRA Guidance Documents</u>

- o Draft Alternate Concentration Limits (ACL) Guidance

a. EPA's RCRA Design Guidelines

(1) Surface Impoundments, Liners Systems, Final Cover and Freeboard Control.

(2) Waste Pile Design - Liner Systems.

(3) Land Treatment Units.

(4) Landfill Design - Liner Systems and Final Cover.

b. Permitting Guidance Manuals

(1) Permit Applicant's Guidance Manual for Hazardous Waste Land Treatment, Storage, Disposal Facilities.

(2) Permit Writer's Guidance Manual for Hazardous Waste Land Treatment, Storage, and Disposal Facilities.

(3) Permit Writer's Guidance Manual for Subpart F.

(4) Permit Applicant's Guidance Manual for the General Facility Standards.

(Continued)

(Sheet 2 of 5)

Table 3.5 (Continued)

(5) Waste Analysis Plan Guidance Manual.

(6) Permit Writer's Guidance Manual for Hazardous Waste Tanks.

(7) Model Permit Application for Existing Incinerators.

(8) Guidance Manual for Evaluating Permit Applications for the Operation of Hazardous Waste Incinerator Units.

(9) A Guide for Preparing RCRA Permit Applications for Existing Storage Facilities.

(10) Guidance Manual on closure and post-closure Interim Status Standards.

c. Technical Resource Documents (TRDs)

(1) Evaluating Cover Systems for Solid and Hazardous Waste.

(2) Hydrologic Simulation of Solid Waste Disposal Sites.

(3) Landfill and Surface Impoundment Performance Evaluation.

(4) Lining of Water Impoundment and Disposal Facilities.

(5) Management of Hazardous Waste Leachate.

(6) Guide to the Disposal of Chemically Stabilized and Solidified Waste.

(7) Closure of Hazardous Waste Surface Impoundments.

(8) Hazardous Waste Land Treatment.

(9) Soil Properties, Classification, and Hydraulic Conductivity Testing.

d. Test Methods for Evaluating Solid Waste.

(1) Solid Waste Leaching Procedure Manual.

(2) Methods for the Prediction of Leachate Plume Migration and Mixing.

(3) Hydrologic Evaluation of Landfill Performance (HELP) Mode.
Hydrologic Simulation of Solid Waste Disposal Sites.

(4) Procedures for Modeling Flow through Clay Liners to Determine Required Liner Thickness.

(5) Test Methods for Evaluating Solid Wastes.

(Continued)

(Sheet 3 of 5)

Table 3.5 (Continued)

(6) A Method for Determining the Compatibility of Hazardous Wastes.

(7) Guidance Manual on Hazardous Waste Compatibility.

4. USEPA Office of Water Guidance Documents

a. Pretreatment Guidance Documents: 304(g) Guidance Document Revised Pretreatment Guidelines (3 Volumes).

b. Water Quality Guidance Documents

(1) Ecological Evaluation of Proposed Discharge of Dredged Material into Ocean Waters (1977).

(2) Technical Support Manual: Waterbody Surveys and Assessments for Conducting Use Attainability Analyses (1983).

(3) Water-Related Environmental Fate of 129 Priority Pollutants (1979).

(4) Water Quality Standards Handbook (1983).

(5) Technical Support Document for Water Quality-based Toxics Control.

c. NPDES Guidance Documents.

(1) NPDES Best Management Practices Guidance Manual (June 1981).

(2) Case Studies on toxicity reduction evaluation (May 1983).

d. Ground Water/UIC Guidance Document.

(1) Designation of a USDW.

(2) Elements of aquifer identification.

(3) Interim guidance for public participation.

(4) Definition of major facilities.

(5) Corrective action requirements.

(6) Requirements applicable to wells injected into, through, or above an aquifer which has been exempted pursuant to §146.104(b)(4).

(7) Guidance for UIC implementation on Indian lands.

(Continued)

(Sheet 4 of 5)

Table 3.5 (Concluded)

5. USEPA Manuals from the Office of Research and Development

- o EW 846 methods - laboratory analytical methods.
- o Lab protocols developed pursuant to Clean Water Act 301(h).

Manual for Hazardous Waste Land Treatment, Storage, Disposal Facilities.

(2) Permit Writer's Guidance Manual for Hazardous Waste Land Treatment, Storage, and Disposal Facilities.

(3) Permit Writer's Guidance Manual for Subpart F.

(Sheet 5 of 5)

"Your request for specific criteria on parameters of concerns is not feasible at this time. The Department has no established cleanup criteria as do many other State and Federal regulatory agencies. The chemical form and bioavailability of most heavy metals as well as other toxic and/or bioaccumulative substances determine the potential mode and rate of effect. Our principal objective in evaluating any project-related data is to identify substances of concern to fish and/or wildlife and suggest or seek biological means to identify any potential deleterious effects. We consider any exposure, regardless of duration which causes mortality, or impairment of sensory, respiratory, or reproductive functions of fish or wildlife, or contamination which renders fish or wildlife unfit for human consumption to be deleterious. We also consider the requirements and criteria established by other agencies in evaluating impacts on fish and wildlife resources, notably the water quality objectives set by the Regional Water Quality Control Board and the State Water Resources Control Board under authority of the California Porter-Cologne Act and the Federal Clean Water Act. However, in most cases absolute numerical criteria do not provide the range of considerations we try to employ to protect fish and wildlife resources."

The California Regional Water Quality Control Board, San Francisco Bay Region identified the California Water code as a potential ARAR.

The Bay Area Air Quality Management District identified the California Health and Safety Code as a potential ARAR.

The California Department of Health Services provided the "California Standards, Requirements, Criteria, and Limitation for Hazardous Waste Cleanups Pursuant to Section 121(d)(2) of the Superfund Amendment and Reauthorization Act, June 1987." This list is presented in Table 3.6 (California Department of Health Services (1988). In addition, DOHS provided a list of chemical specific action levels for a variety of chemicals.

3.4 Potential Site Specific Action Levels

Remedial actions are those responses to releases that are consistent with permanent remedy to prevent or minimize the release of hazardous substances so that they do not migrate to cause substantial danger to present or future public health or welfare or the environment (USEPA 1984b). This is to be accomplished using a cost effective remedial action alternative that does not in itself pose a significant long term adverse impact to important wildlife habitat. To implement these goals, site specific action levels were developed.

Table 3.6

California Standards, Requirements, Criteria and Limitations for Hazardous Cleanups Pursuant to Section 121(d)(2) of the Superfund Amendments and Reauthorization Act.

September, 1987

Statutes	Regulation	Applicability	Regulatory Agency
I. Statutes and Regulations			
Air Resources Act Health and Safety Code, Division 26, Section 39000 et seq.	17 CAC, Part III, Chapter 1 Section 60,000 et seq.	Air Quality (Refer also to air district requirements in Section II)	Air Resources Board
California Coastal Act of 1976 Public Resources Code, Division 20 Section 30,000 et seq.		Activities in Coastal Zone Coastal Management Program	California Coastal Commission
California Environmental Quality Act, Public Resources Code Division 13, Section 21000 et seq.	14 CAC, Division 6, Chapter 3 Section 15000 et seq.	CEQA Law and Guidelines. EIR process and alternatives	Resources Agency Office of Planning and Research
California Health and Safety Code Div. 20	California Administrative Code, Title 22, Diviision 4 Chapter 30, Minimum Standards for Management of Hazardous and Extremely Hazardous Wastes.		Department of Health Services

Table 3.6 (Continued)

Statutes	Regulation	Applicability	Regulatory Agency
I. Statutes and Regulations (Continued)			
Chapter 6.5 Hazardous Wastes.		Management and Control of TSD facilities, Transportation, Hauling, Laboratories, Fees, Waste Classification	Department of Health Services
Chapter 6.6 Safe Drinking Water and Toxics Enforcement Act (Proposition 65)		Reproductive Toxin Levels Reporting of hazardous materials releases to local government	Department of Health Services
Chapter 6.7 Underground Storage of Hazardous Substances		Underground tank construction and containment	Department of Health Services State Water Resources Control Board Regional Water Quality Control Board
Chapter 6.8 Hazardous Substance Account		Principal requirement governing State Superfund and Board program abandoned sites, emergency response, victim's compensation	Department of Health Services
Chapter 6.91 Hazardous Materials Duty		Notification to local government officials of the use and dangers imposed by hazardous materials.	Office of Emergency Services

Table 3.6 (Continued)

Statutes	Regulation	Applicability	Regulatory Agency
I. Statutes and Regulations (Continued)			
		Community information program	
Chapter 6.95 Hazardous Materials Release Response Plans and Inventory	19 CAC, Chapter 3, Subchapter 3	Emergency plans in the event of hazardous materials release or threatened release	Office of Emergency Services
Chapter 6.98 Environmental Quality Assessment		Registration of Environmental Assessors	Department of Health Services State Water Resources Control Board Air Resources Board
California Safe Drinking Water Act, Health and Safety Code, Division 7, Part 1, Chapter 7 Section 4010 et seq.	California Administrative Code, Title 22, Division 4, Chapter 15, Domestic Water Quality and Monitoring	Public Water Systems Drinking Water Standards Maximum Contaminant Levels (MCLs), Lab Certification	Department of Health Services, Sanitary Engineering
Hazardous Substances Act, Health and Safety Code Division 22, Chapter 13, Section 28740 et seq.		"Hazardous Substance" and "Toxic" broadly defined	Department of Health Services
Occupational Health and Safety Act, Labor Code Section 6300, et seq.		Worker safety, responsibilities and duties of employer.	Department of Industrial Relations, Division of Industrial Safety.

Table 3.6 (Continued)

Statutes	Regulation	Applicability	Regulatory Agency
I. Statutes and Regulations (Continued)			
Porter Cologne Water Quality Control Act, Water Code, Division 7 Section 13000 et seq.	California Administrative Code, Title 23, Chapter 3	Identification of general duties and authorities of State and Regional Water Boards	State Water Resources Control Board Regional Water Quality Control Board Department of Health Services
	Subchapter 9, Waste Discharge Reports and Requirements		
	Subchapter 9.1, Enforcement Procedures and Septic Tank Prohibition Review by the (Water) Board.		
	Subchapter 10, Licensing and Regulation of Use of Oil Spill Cleanup Agents.		
	Subchapter 13, Registration and Regulation of Liquid Waste Haulers.		
	Subchapter 15, Discharges of Waste to Land.		
	(23 CAC, Chapter 3 Cont.) Subchapter 16, Underground Tank Regulation	Underground Tanks	

Table 3.6 (Continued)

Statutes	Regulation	Applicability	Regulatory Agency
I. Statutes and Regulations (Continued)			
	Subchapter 20, Standards for Removal of Sewage from Vessels		
Fish and Game Code, Division 6, Part 1, Chapter 2, Sections 5650 and 5651		Fish and Wildlife, Water Pollution Prohibition, Correction of Chronic Water Pollution	Department of Fish and Game
	California Administrative Code, Title 8, Chapter 4	Health and Safety Requirements	
	Subchapter 4, Construction Safety Orders		
	Subchapter 5, Electrical Safety Orders		
	Subchapter 7, General Industry Safety Orders		
	California Administrative Code, Title 14, Division 7, Chapter 3. Standards for Solid Waste Handling and Disposal.		Solid Waste Management Board
	California Administrative Code, Title 17, Chapter 5, Subchapter 4, Group 3, Article 6, Section 30298.	Cleanup of radioactive bearing hazardous waste in buildings.	Department of Health Services

Table 3.6 (Continued)

Statutes	Regulation	Applicability	Regulatory Agency
I. Statutes and Regulations (Continued)			
	California Administrative Code, Title 19, Chapter 2, Subchapter 3, Hazardous Materials Release Response	Emergency Response (Office of Emergency Services)	Office of Emergency Services (OES)
	California Administrative Code, Title 23, Chapter 4, Subchapter 15. Regulations for Implementation of the California Environmental Quality Act of 1970 (Water Board Requirements)	Water Board CEQA Regulations	State Water Resources Control Board, Regional Water Quality Control Board
	California Administrative Code, Title 26, Toxics	Directory of Toxic Related Regulations.	Office of Administrative Law
II. Other Standards, Requirements, Criteria and Limitations			
All policies and procedures for hazardous waste and hazardous materials management and cleanup adopted by the Toxic Substances Control Division.			Department of Health Services
Department of Health Services Decision Tree.	Development of site-specific cleanup levels evaluation of remedial action alternatives.		Department of Health Services
Department of Health Services Exposure Criteria.			Department of Health Services

Table 3.6 (Continued)

Statutes	Regulation	Applicability	Regulatory Agency
I. Statutes and Regulations (Continued)			
o RMCLs, MCLs, and action levels* for unregulated chemicals in drinking water. o Applied action levels* developed by the Toxic Substances Control Division. o Other cleanup levels deveioped by the Toxic Substances Control Division on a site specific basis.			
Toxic air quality criteria policies or standards generated Department Health Services by the Department of Health Services or the Air Resources Board.			Department of Health Services Air Resources Boards
Air Pollution Control District regulations.			Local Air Pollution Control District
South Coast Air Quality Management District Rule 1150, Excavation of Landfill Sites.		Permit requirements for excavation at landfill sites.	South Coast Air Quality Management District

Table 3.6 (Continued)

Statutes	Regulation	Applicability	Regulatory Agency
II. Other Standards, Requirements, Criteria and Limitations (Continued)			
South Coast Air Quality Management District Rule 1150.1, Control of Gasout Emissions from Active Landfills. Storage Tanks.		Gas collection at active landfills.	South Coast Air Quality Management District Underground
Bay Area Air Quality Management District Regulation 8 Rule 40, Aeration of Contaminated Soil and Removal of Underground Storage Tanks.		Control of organic compounds during removal of underground tanks	Bay Area Air Quality Management District
Water Quality Control plans of the State Water Resources Control Board and the Regional Water Quality Control Board.		Water Quality and Basin Plans	State Water Resources Control Board Regional Water Quality Control Board
Other requirements of the State Water Resources Control Board and the Regional Water Quality Control Boards.			State Water Resources Control Board Regional Water Quality Control Board
All policies and procedures for water quality control adopted by the State Water Resources Control Board and the nine Regional Water Quality Control Boards.		Includes "Non Degradation" Policy	State Water Resources Control Board Regional Water Quality Control Board

Table 3.6 (Concluded)

Statutes	Regulation	Applicability	Regulatory Agency
Regional Water Quality Control Board cleanup levels.			Regional Water Quality Control Board
Regional Water Quality Control Board site remediation guidance and criteria.			Regional Water Quality Control Board
All county hazardous waste management plans.			Department of Health Services
Hazardous Waste Move Committee Memorandum of Understanding.		Transportation of Hazardous waste during cleanup.	Department of Health Services, Department of Transportation, Highway Patrol
General Orders of the Public Utilities Commission.			Public Utilities Commission

Notes:

1. Pursuant to the Superfund Amendments and Reauthorization Act, Section 121(e), and associated state policies and requirements, permits may not be mandatory at Superfund sites.

2. The "Applicability" column is intended only to highlight some major elements of the statute or regulation. It is not designed to denote which sections of the code or statute apply.

3. The Department of Health Services reserves the right to amend this list pursuant to the intent of the Superfund Amendments and Reauthorization Act.

The primary media of concern for each RASS included in the feasibility study at the NWS Concord are contaminated soils. Two general types of threats are considered when developing criteria for soils: (1) direct contact by intruders onto the site, and (2) contamination of other environmental media by the soils (USEPA 1985). For locations containing important wildlife habitat, such as those found on NWS Concord, the potential for biological uptake, bioaccumulation, and bioconcentration must also be addressed. Unfortunately, there are no currently promulgated environmental criteria or standards for contaminants in soils, except PCB-contaminated soils.

In those cases where no specific criteria or standards are available, the extent to which other Federal environmental and public health requirements are applicable or relevant and appropriate to a specific site, and the extent to which other Federal criteria, advisories, and guidance and State standards are pertinent may be considered in developing the remedy (USEPA 1984b). For NWS Concord, a variety of possible criteria and standards were evaluated. Specific criteria for each RASS were developed to account for the different conditions found on each RASS. Criteria initially considered in the RI (Lee et al. 1986) are presented in Table 3.7. Potential criteria for use in this FS are presented in Table 3.8. These are discussed individually below.

3.4.1 Contaminant Content of Soils.

3.4.1.1 Absolute Relationship to Reference Levels. Consideration was given to the remediation of contaminated soils above typical concentrations found in reference areas, Sites BK116 and BK133 on Figure 2, not believed to be impacted by the contamination. This may be an appropriate criterion since the release of metal contamination has resulted in concentrations exceeding those of soil concentrations prior to the release or discharge of contamination. Cleanup of all contaminated soil would return the environment to its original condition as indicated by the soil metal concentrations found at the reference areas. Application of this criterion would represent a strict interpretation of the RCRA standard for clean closure and would result in the largest area for implementation of remediation.

Table 3.7

Criteria Used for Evaluation in the RI

Criteria	Measure of Contamination
Soil Contents	Exceeding remote reference areas Statistically above reference areas Exceeding MASSA[1] Exceeding direct contact (soil ingestion)
Mortality	Plants Earthworms Soil invertebrate diversity/abundance
Bioaccumulation	
Plants	Critical content
	Statistically above reference areas FDA
Earthworms	Statistically above reference areas FDA
Clams	Statistically above reference areas FDA

1 MASSA - Maximum Allowable Sewage Sludge Application.

Based on a general understanding of environmental response to contamination and site specific information collected during the RI, application of this criterion may be overly protective. The environment has a certain assimilation capacity before an adverse impact occurs and in some areas of the contaminated sites an adverse environmental impact is not readily apparent. In addition, clean up of the large area that would be required if this criterion were applied would result in the temporary and possibly long term loss of an extensive amount of productive wildlife habitat and wildlife, including endangered species, currently living in the area.

3.4.1.2 Statistical Relationship to Reference Levels. Since soil metal concentrations in both the reference and contaminated areas varied widely, the use of statistical differences in soil values in the reference areas, Sites BK116 and BK133 on Figure 2 were evaluated as an alternative criteria to the clean up to reference criterion. Application of this criteria accounts for the variability of soil concentrations existing on a soil surface prior to the contamination by a discharge or release of metal contaminants. This criteria is less conservative than the return to reference area quality, and would result in reduced removal of hazardous substances. This criterion, however, does not consider the biological impact of increased soil metal content. Application of this criteria would result in extensive areas of

Table 3.8

Potential Criteria for Evaluating Scope of Required Remediation

Criterion	Measure of Contamination
Contaminant Content of Soils	Exceeding Highest Background Level
	Statistically Exceeds Background Level
	Exceeding MASSA
	Exceeding TTLC
	Exceeding STLC
	Exceeding EP
	Low pH
Direct Contact	Exceeds California DOHS Recommendations
Human Ingestion	Soil Ingestion Standards
Bioaccumulation	
Plants	Critical Content
	Statistically Above Reference Areas
	FDA Standards
Animals	
Earthworms	Statistically Above Reference Areas
	FDA Standards
Mice and voles	Statistically Above Reference Areas
	FDA Standard
Clams	Statistically Above Reference Areas
	FDA Standards
Indirect Contact	
Surface Water	Ambient Water Quality Standards
Ground Water	Drinking Water Standards (MCL or MCLG)
Air	California Applied Action Levels
Habitat Quality	Death of Plants or Animals
	Undesirable Change in Biotic Composition
	Extent of Barren Areas

remediation and would have a major impact on existing wildlife, including endangered species, and habitat.

3.4.1.3. Maximum Allowable Sewage Sludge Application (MASSA). The United States Department of Agriculture has established guidelines for the maximum amount of sewage sludge metals that can be applied to agricultural cropland (Table 3.9). Soil metal concentrations in excess of these values will result in unacceptable contamination of crops grown on the sludge amended soil. Such crops would be restricted from human and animal consumption. These guidelines can be used to evaluate the suitability of land for agricultural use. The MASSA values were established for arable agricultural land that is usually not

Table 3.9

Background Levels and Allowable Applications of Several Heavy Metals for US Cropland Soils from Holnigren et al. (1987) and Peddicord et al. (1986)

Parameter	Concentration in Surface Soils, mg/kg: 5 Percentile	Median	95 Percentile	No Effect Allowed Addition* kg/ha	Median Allowed Application** mg/kg
Pb	4.0	11	27	1,000	511
Zn	7.3	54	129	500	304
Cu	3.7	19	96	250	144
Ni	3.8	19	59	125	82
Cd	0.035	0.20	0.78	5	2.7
pH	4.6	6.1	8.1	--	--

* Allowed application is mixed into the 0-15 cm (0-6 in.) surface layer of soil.

** Dry weight basis.

flooded for significant time periods during the year; however, these MASSA values can potentially be used for soils that tend to dry out and oxidize during some time during the year. Consequently, the MASSA values could be considered as relevant and appropriate criteria for wetland areas that intermittently dry out during the year. An additional argument for the application of the MASSA criteria is the historical use of the wetland area for animal grazing.

3.4.1.4 Total Threshold Limit Concentration (TTLC) and Soluble Threshold Limit Concentration (STLC). The State of California has selected criteria for identifying hazardous substances that are persistent and bioaccumulative based on the metal concentration as determined by a nitric acid extraction (TTLC) and a citric acid extraction (STLC). If either the TTLC or STLC exceed specified values, the material is considered to be hazardous and must be managed as a hazardous material. The TTLC and STLC criteria were developed to protect ground water at waste disposal landfills and are generally used to evaluate disposal requirements for excavated materials. TTLC and STLC limits are presented in Table 3.10.

Table 3.10

Threshold Limit Concentration*

Parameter	Total, mg/kg (TTLC)	Soluble, mg/ℓ (STLC)
As	500	5.0
Ba	10,000	100
Cd	100	1.0
Cr	2,500	560
Cu	2,500	25
Pb	1,000	5.0
Se	100	1.0
V	2,400	24
Zn	5,000	250

* Wet-weight basis.

3.4.1.5 Extraction Procedure Toxicity. The U.S. Environmental Protection Agency has promulgated the Extraction Procedure Toxicity (EP) for determining the hazardous nature of a contaminated or waste material. The EP test is similar to the STLC test procedure except that an acetic acid leaching fluid is used rather than a citric acid. Materials failing this EP are classified as hazardous and must be handled as RCRA materials. EP criteria are presented in Table 3.11. Like the TTLC/STLC requirements, the EP test is designed to evaluate disposal requirements rather than the need for removal. The USEPA is currently developing a new procedure, the Toxicity Characteristic Leaching Procedure (TCLP), that is expected to replace the EP as the appropriate test method. For metals analysis, however, the EP and TCLP are nearly identical.

3.4.1.6 Low Soil pH Values. A measure of the soil's acidic nature can be used as a criterion because of associated biological and chemical reactions. The presence of bacteria is curtailed when pH falls below 5.5, and many plant species and soil invertebrates cannot live and survive in strongly acid soils. At low pH values, some contaminants such as cadmium, copper, nickel, lead, zinc, and iron become toxic, while others such as phosphorous become unavailable for plant uptake. This criterion is readily measured and consequences of a change in pH are based on extensive research.

3.4.1.7 California DOHS Recommendation. The California Department of Health Services provides general guidance on the acceptable limit of contaminants in soils (DOHS 1986). In general, the methodology suggests calculations of the

Table 3.11

Limiting Criteria for Extraction Procedure (EP) Leachate

Parameter	Concentration (mg/ℓ)
Arsenic	5.0
Barium	100.0
Cadmium	1.0
Chromium	5.0
Lead	5.0
Mercury	0.2
Selenium	1.0
Silver	5.0
Endrin (1,2,3,4,10,10-hexa-chloro-1,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4-endo, endo-5,8-dimeth-ano-naphthalene.	0.02
Lindane (1,2,3,4,5,6-hexa- chlor-oxychlohexane, gamma isomer.	0.04
Methoxychlor (1,1,1-Trichloro-2,2-bis [p-methoxy-phenyl]ethane)	10.0
Toxaphene ($C_{10}H_{10}C$__ Technical chlorinated camphene, 67-69 percent chlorine).	0.5
2,4-D (2,4-Dichlorophenoxy-acetic acid).	10.0
2,4,5-TP Silvex (2,4,5-Tri-chlorophenoxyproplonic acid).	1.0

$$RSCL = DWS \times 100 \times 10$$

where:

RSCL = recommended soil cleanup level,

DWS = drinking water standard

100 = attenuation of contaminant in soil, and

10 = dilution of contaminant by groundwater.

recommended soil cleanup level (RSCL) using methodologies similar to those used to calculate levels that are used to designate Group I waste. In general, the cleanup level is calculated as follows.

3.4.2 Direct Contact.

3.4.2.1 Human Ingestion. Criteria that protect the health of humans or animals coming into direct contact with the contaminated soils may be relevant and appropriate at the various sites. This criteria considers the continual and direct contact of humans and wildlife with hazardous substances. Such criteria were developed for Celtor Chemical (USEPA 1985). These criteria are summarized in Table 3.12. The criteria presented in Table 3.12 are based on the standards promulgated under the Clean Water Act (CWA) and the Safe Drinking Water Act (SDWA). Specifically, allowable soil concentrations were determined using the National Ambient Water Quality Criteria for Protection of Human Health (WQCPHH) or the Maximum Contaminant Level (MCL's), as promulgated under the CWA and SDWA respectively. First, an acceptable daily dose was computed by multiplying the WQCPHH or MCL for a given contaminant by two liters, which is the maximum daily ingestion rate. This computed daily dose is then divided by 10 grams or 0.1 gram, which is the U.S. Center for Disease Control (CDC) maximum estimated ingestion rate of soil for a child and adult, respectively. The result is a range of contaminant concentration in the soil that would fully protect human health.

Table 3.12

Action Levels Based on Soil Ingestion[1]

Parameter	Concentration[2] (mg/kg)	Concentration[3] (mg/kg)
Arsenic	10-10,000	100
Cadmium	2-200	25
Copper	200-20,000	2,500
Lead	10-1,000	500
Zinc	1,000-100,000	5,000

1. USEPA 1985 (Celtor Chemical Record of Decision).
2. Based on application of ambient water quality criteria for protection of human health.
3. Action levels selected for Celtor Chemical site.

3.4.2.2 Bioaccumulation. One of the major impacts associated with contaminated soils is the actual and/or potential bioaccumulation of contaminants in plants and animals inhabiting the area of contamination. The bioaccumulation

criteria considers the potential for biological impact of metal contamination in the environment as a function of the movement of metals from the soil into biota in contact with the contaminated soils. This criterion would be closely related to adverse biological impact of a discharge or release of hazardous substances. Extensive bioaccumulation studies using an aquatic animal (a clam, *Corbicula fluminea*); a plant (*Cyperus esculentus*); and a soil invertebrate (the earthworm, *Eisenia foetida*) were conducted as a part of the RI (Lee et al. 1986). In addition, and subsequent to the RI, tissue analyses were performed on specimens of the house mouse (*Mus musculus*) and California vole (*Microtus californicus*) collected from RASS 1 and 2. Bioassay procedures using these organisms to indicate potential toxicity and bioaccumulation of hazardous substances could be used to establish clean up criteria. However, an application of a bioaccumulation criterion is difficult because of the extensive and complex testing regimes that would be required to verify contaminant uptake and the variety of criteria that could potentially be applied.

A variety of criteria could be applied to determine unacceptable levels of bioaccumulation in plants and animals. Table 3.13 presents action levels for contaminants accumulated in aquatic organisms. Table 3.14 presents action levels based on phytotoxicity in plant materials. Tables 3.15 and 3.16 present action levels for contaminant concentrations in plants and foodstuffs. Table 3.17 summarizes soil concentration criteria developed by a variety of authors for plant bioaccumulation and toxicity as well as for soil ingestion.

3.4.3 Indirect Contact.

3.4.3.1 Ambient Water Quality Criteria. Ambient water quality criteria (AWQC) have been promulgated under the Clean Water Act for the protection of human health and aquatic organisms. The AWQC for the contaminants of concern at NWS Concord are presented in Table 3.18.

The AWQC were developed to assess water quality. Such criteria cannot be directly applied to contaminated soil media. The AWQC can be applied as an indicator of the need for remedial actions if surface water quality is determined to violate AWQC.

Table 3.13

Action Levels for Contaminants in Aquatic Organisms for Human Consumption from Peddicord et al. 1986

Chemical	Food	Action Level* mg/kg (wet weight edible portions)	Maximum Concentration** mg/kg (wet weight edible portions)
Aldrin	Fish and shellfish	0.3	
Antimony	All nonspecified foods (including seafood)		1.5
As	Fish, crustacea, molluscs		1.0
Cd	Fish		0.2
	Molluscs		1.0
Chlordane	Fish	0.3	
Cu	Molluscs		70.0
	All nonspecified foods (including seafood)		10.0
DDT, DDE, TDE	Fish	5.0	
Dieldrin	Fish and shellfish	0.3	
Endrin	Fish and shellfish	0.3	
Heptachlor, Heptachlor epoxide	Fish and shellfish	0.3	
Hexachlorocyclohexane (Benzene hexachloride)	Frog legs		0.5
Kepone	Fish and shellfish	0.3	
	Crabmeat	0.4	
Pb	Molluscs		2.5
	All nonspecified foods (including seafood)		1.5

(Continued)

* United States Food and Drug Administration (FDA) Action Levels for Poisonous or Deleterious Substances in Human Food.

** Australian National Health and Medical Research Council Standards for Metals in Food, May 1980

Action level is for these chemicals individually or in combination. However, in adding concentrations, do not count any concentrations below the following levels:

Chemical	Minimum Level (mg/kg)
DDT, DDE, TDE	0.2
Heptachlor, heptachlor epoxide	0.3

Table 3.13 (Concluded)

Chemical	Food	Action Level* mg/kg (wet weight edible portions)	Maximum Concentration** mg/kg (wet weight edible portions)
Hg	Fish, crustacea, molluscs		0.5
Methylmercury	Fish, shellfish, other aquatic animals	1.0	
Mirex	Fish	0.1	
PCB (total)	Fish and shellfish	2.0	
Se	All nonspecified foods (including seafood)		1.0
Tin	Fish		50.0
Toxaphene	Fish	5.0	
Zn	Oysters		1,000.0
	All nonspecified foods (including seafood)		150

** This is not an action level but a tolerance limit established through the rulemaking process.

The AWQC can be used as a rough estimate of the toxicity of various contaminants.

3.4.3.2 Drinking Water Criteria. Maximum Contaminant Limits (MCL's) and Maximum Contaminant Limit Goals (MCLG's) have been proposed and/or promulgated under the Safe Drinking Water Act. The MCL's and MCLG's for the contaminants of concern at NWS Concord are presented in Table 3.19. MCL's and MCLG's are specifically identified by SARA as being potentially relevant and appropriate for CERCLA remedial actions.

The MCL's and MCLG's cannot be directly applied as action levels for cleanup of contaminated soils. However, they are an indicator of the need for remedial actions if ground water is affected. Since contamination on all the RASS's on NWS Concord is believed to be surface soil contamination, the MCL and MCLG values are only of indirect value in determining cleanup action levels.

Table 3.14

Demonstrated Effects of Contaminants on Plants

(Taken in part from Table C-5 in Lee et al. 1984)

		Plant Growth			
Contaminant	Normal*	"Critical" Content** mg/kg leaves	10% Yield Reduction mg/kg leaves	25% Yield Reduction mg/kg leaves	Phytotoxic
As	0.1-1	--	--	--	3-10
Cd	0.1-1	8	15	Varies	5-700
Cu	3-20	20	20	20-40	25-40
Ni	0.1-5	11	26	50-100	500-1000
Pb	2-5	--	--	--	--
Se	0.1-2	--	--	--	100
Zn	15-150	200	290	500	500-1500

All values are dry weight basis.

* From Chaney (1983). Normal--tissue content normally observed in healthy plants.

** From Davis et al. (1978), Davis and Beckett (1978), and Beckett and Davis (1977). Tissue content above which detrimental effects have been observed in plants.

From Chaney (1983). Phytotoxic--tissue content observed in dying or dead plants.

3.4.3.3 California Applied Action Levels. The California Department of Health Services provided applied action levels for a variety of chemicals. Those that are relevant to NWS Concord are listed in Table 3.20.

3.4.4 Habitat Quality

Another criterion that might be appropriate to the NWS Concord contamination is the current status of wildlife habitat. This criterion may be applied by using a quantitative evaluation of habitat quality or by subjective impressions. The basic determinants of quality are the availability of adequate food and cover for residents and users of the area, and the lack of factors that injure organisms and populations. Biological determinants are primarily the composition of the plant and animal communities, i.e., species' presence or absence, distribution, relative abundance, diversity, biomass, and growth form. Physical factors such as drainage, soil texture, and land use of

Table 3.15

Action Levels for Various Heavy Metals and Pesticides in Plants and Foodstuffs

Substance	Commodity	Data Source*	Action Level	Type of Limit**	Step	Reference
As	Non-pulpy black-currant nectar	3	0.2 mg/kg			CAC/RS 101-1978
	Fructose	3	1 mg/kg			CAC/RS 102-1978
	Cocoa powders and dry cocoa-sugar mixtures	3	1 mg/kg			CAC/RS 105-1978
Cd	Provisional weekly tolerance intake for humans	2	0.0067-0.0083 mg/kg body weight			
Pb	Non-pulpy black currant nectar	3	0.03 mg/kg	--	--	CAC/RS 101-1978
	Cocoa powders and dry cocoa-sugar mixtures		2 mg/kg	--	--	CAC/RS 105-1978 App. V, CS 5/70
	Edible acid casein		2	--	--	18th session
	Edible caseinates		2	--	--	App. VI, CS 5/70 18th session
Zn	Non-pulpy black currant nectar		5 mg/kg	--	--	CAC/RS 101-1978
Cu	Non-pulpy black-currant nectar		5 mg/kg	--	--	CAC-RS/101-1978
	Fructose		2 mg/kg	--	--	CAC/RS/102-1978
	Cocoa powders and dry cocoa-sugar mixtures		50 mg/kg	--	--	CAC/RS 105-1978
	Edible acid casein		5 mg/kg	--	--	18th sessions-1976
	Edible caseinates		5 mg/kg	--	--	App. VI, CS 5/70 18th session-1976

* Data source: 1 = FDA action levels for poisonous or deleterious substances in human food and animal feed; 2 = FAO/WHO guide to Codex Maximum Limits for Pesticide Residues; and 3 = list of maximum levels recommended for contaminants by the joint FAO/WHO Codex Alimentarius Commission. Joint FAO/WHO food standards programme Codex Alimentarius Commission CAC/FAL 4-1978.

** Type of limit: CPG = Compliance Policy Guidelines; TT = Temporary Codex Tolerance; TC = Codex Tolerance; and PRL = Practical Residue Limit. Step = "Step" in the procedure for the elaboration of Codex Maximum Limits for Pesticide Residue given in the FAO/WHO Guide to CODEX M. Reference = Refers to CPG number.

Table 3.16

Additional Action Levels for Contaminants in Foodstuffs Used by Other Countries

Source	Contaminant	Commodity	Content, mg/kg	References
Britain	Pb	All foods	1.0 (fresh wt)	M.A.F.F. (1972)
World Health Organization (WHO)	Pb	Root vegetables	0.1 (fresh wt)	WHO (1972)
		Cereal	0.1 (fresh wt)	
		Leafy vegetables	1.2 (fresh wt)	
	Cd	Root vegetables	0.05 (fresh wt)	WHO (1972)
		Leafy vegetables	0.1 (fresh wt)	
		Potatoes, cereal	0.1 (fresh wt)	
Dutch	Cu	Animal feed	20.0 (dry wt)	DMAFCMN (1973)
Dutch (unofficial)	Cd	Single animal feed	0.05 (dry wt)	European Community (1974)
		Mixed animal feed	1.0 (dry wt)	
		Roughage	1-2 (fresh wt)	
European Economic Community	Pb	Single animal feed	10.0 (dry wt)	Van Driel et al. (1982)
		Mixed animal feed	5.0 (dry wt)	
		Roughage	40.0 (fresh wt)	
FDA (as of Sep 82)	Hg	Wheat seed	1.0 (dry wt)	FDA (1982)
	PBB	Animal feed	0.5 (dry wt)	
	Various pesticides	Vegetables, grains and feeds	0.03-0.1	

Table 3.17

Recommended or Regulated Limitations on Potentially Toxic Constituents in Surface (0-15 cm) Soils from Lee et al. (1986)

Basis for Limitation	Contaminant	Soil Concentration	Reference
Soil Ingestion	Pb	500 mg/kg	EPA (1977)
	Hg	5 mg/kg	
	PCBs etc.	2.0 mg/kg	Fries (1982)
Plant Uptake	Cd	2.5 mg/kg (pH 5.5)	EPA (1979)
Phytotoxicity	Zn	250 mg/kg	Logan and Chaney (1983)
	Cu	125 mg/kg	
	Ni	62 mg/kg	
	Co	62	

All values are dry weight basis.

adjacent areas are also considerations. Chemical factors such as the presence of hazardous substances in concentrations greater than reference or previous conditions are also determinants of habitat quality.

The presence of areas on NWS Concord that do not support vegetation, perhaps because of elevated concentrations of hazardous substances, is a subset of the habitat quality criterion. These areas are easily identified through visual inspection and are generally discrete in their distribution. Barren areas are a potential criterion because, in addition to lacking vegetation with its associated attributes and life forms, they support less diversity and abundance of soil invertebrates due to the lack of plant roots. These factors result in lowered quality of habitat for most organisms, whether or not any hazardous substances are present and available.

3.5 Selection of Criteria for Level of Remediation

3.5.1 Analysis of Remediation Area for Potential Criteria. The application of the potential criteria evaluated in Section 3.3 result in the remediation of substantially different areas. The area of remediation for each potential

Table 3.18

Ambient Water Quality Criteria

Chemical	Protection of Aquatic Organisms: Freshwater Acute (μg/ℓ)	Freshwater Chronic (μg/ℓ)	Marine Acute (μg/ℓ)	Marine Chronic (μg/ℓ)	Protection of Human Health: Fish Consumption Only (μg/ℓ)	Water and Fish Ingestion (μg/ℓ)
Arsenic (total)	-	-	-	-	0.0175[2]	0.0022[2]
Arsenic (V)	850.[3]	48.[3]	2,319.[3]	13.[3]	-	-
Arsenic (III)	360.	190.	69.	36.	-	-
Cadmium	3.9[4]	1.1[4]	43.	9.3	-	10.
Chromium (VI)	16.	11.	1,100.	50.	-	50.
Chromium (III)	1,700.[4]	210.[4]	10,300.[3]	-	3,433.mg/ℓ	170.mg/ℓ
Copper	18.[4]	12.[4]	2.9	-	1,000.[5]	1,000.[5]
Iron	-	1,000.	-	-	-	0.3 mg/ℓ
Lead	82.[4]	3.2[4]	140.	5.6	-	50.
Nickel	1,400[4]	160.[4]	75.	8.3	100	13.4
Selenium	260.	35.	410.	54.	0	10.
Zinc	120.[4]	110[4]	95	86	5,000.[5]	5,000[5]

1 All values in μg/ℓ unless otherwise noted.

2 Human health criteria for carcinogen reported at 10^{-6} risk level.

3 Insufficient data to develop criteria. Value presented in lowest observed effect level (LOEL).

4 Hardness dependent criteria (100 mg/ℓ $CaCO_3$ used).

5 Insufficient data to develop criteria value presented base on organoleptic data.

Source: EPA 440/5-86-001, "Quality Criteria for Water," (The Gold Book).

criteria that addresses soil contamination is presented in Table 3.21. For purposes of this study, contamination is defined as areas where soil contents are statistically above reference area level plus areas of statistically significant bioaccumulation in plants and animals. The area of proposed remediation under each criteria is illustrated in the set of figures (Lee, Cullinane, O'Neil 1988) that accompany this volume of the FS. Table 3.22 presents a key matrix to these figures and the respective cleanup criteria.

Table 3.19

National Drinking Water Standard

Parameter	Maximum Contaminant Level (μg/ℓ)	Maximum Contaminant Level Goal (μg/ℓ)
Arsenic	50	50
Cadmium	10	5
Chromium (Total)	50	120
Copper[1]	1000	1300
Iron[1]	300	--
Lead	50	20
Nickel	--	--
Selenium	10	45
Zinc	5,000[1]	--

1 Secondary Standard. All other parameters are primary standards.

Table 3.20

California Applied Action Levels (AAL) for Water

Substance	Biological Receptor	AALwater (mg/l)	Test Comment
Arsenic	Aquatic	0.074	Freshwater species
Arsenic	Aquatic	0.0224	Saltwater species
Cadmium	Aquatic	0.00017	Freshwater species
Cadmium	Aquatic	0.0051	Saltwater species
Chromium	Aquatic	C.051	Freshwater species
Chromium	Aquatic	0.00153	Saltwater species
Copper	Aquatic	0.0043	Freshwater species
Copper	Aquatic	0.0060	Saltwater species
Lead	Aquatic	0.012	Freshwater species
Lead	Aquatic	0.0044	Saltwater species

Table 3.21

Summary of Remediation Area for Potential Criteria

	Area Exceeding Soil Metal Contents of Reference Area	Soil Metal Statistically Higher Than Reference Area	Soil Metal Content Exceed MASSA	Bioaccumulation of Metals in Plants & Animals	Area of Contamination	Exceeding STLC or TTLC Values	Barren Areas
Rass 1							
572 N	80.03	19.24	0.19	28.82	31.42	15.40	1.03
571 N	3.90	--	--	0.06	0.06	--	--
571 SF	0.45	--	--	0.02	0.02	--	--
571 SP	0.04	--	--	--	--	--	--
CC	--	--	--	--	--	--	--
CC SF	--	--	--	--	--	--	--
CC SP	--	--	--	--	--	--	--
Other N	0.01	--	--	0.01	0.01	--	--
Other SF	--	--	--	--	--	--	--
Other SP	--	--	--	--	--	--	--
Stream	0.99	--	--	0.60	0.60	--	--
SUBTOTAL	85.42	19.24	0.19	29.51	32.11	15.40	1.03
Rass 2							
572 N	9.21	1.61	1.80	1.84	1.99	2.33	0.67
572 SF	3.06	0.83	1.78	0.56	0.78	1.39	0.56
572 SP	0.31	--	--	--	--	0.03	--
SUBTOTAL	12.58	2.44	3.58	2.40	2.77	3.75	1.23

(Continued)

Table 3.21 (Concluded)

	Area Exceeding Soil Metal Contents of Reference Area	Soil Metal Statistically Higher Than Reference Area	Soil Metal Content Exceed MASSA	Bioaccumulation of Metals in Plants & Animals	Area of Contamination	Exceeding STLC or TTLC Values	Barren reas
RASS 3							
573 Other SP	0.04	--	--	--	--	--	--
573 Other N	0.66	--	--	0.02	0.02	--	--
573 Other SF	--	--	--	--	--	--	--
573 SP	0.36	--	0.50	--	0.34	--	--
573 N	3.57	2.87	0.17	2.08	2.92	0.34	--
573 SF	--	--	--	--	--	--	--
574 SP	0.48	0.31	0.50	--	0.31	0.09	--
574 N	1.06	1.05	0.88	0.95	1.41	1.28	--
574 SF	--	--	--	--	--	--	--
575 SP	0.14	--	0.13	Trace	--	--	--
575 N	1.12	0.20	1.72	Trace	0.20	0.09	--
575 SF	0.04	0.01	0.17	0.01	0.01	0.05	--
576 SF	0.10	0.08	0.09	0.02	0.10	0.04	--
576 N	0.01	0.01	Trace	0.03	0.03	--	--
576 SN	0.04	0.04	0.03	0.05	0.08	Trace	--
579D-Other-N	0.47	--	--	--	--	--	--
579D-N	0.54	0.01	0.14	0.54	0.62	Trace	--
579D-SN	0.03	--	--	0.05	0.05	0.01	--
579D-CP	--	--	--	--	--	--	--
579D-CP-SN	--	--	--	0.02	--	0.02	--
SUBTOTAL	8.66	4.58	4.33	3.77	6.09	1.92	--
RASS 4							
581-N	4.88	0.19	2.58	0.08	0.25	0.56	--
581-Other-N	0.43	Trace	--	Trace	Trace	--	--
SUBTOTAL	5.31	0.19	2.58	0.08	0.25	0.56	--
TOTAL	111.97	26.45	10.68	35.76	41.22	21.63	2.26

All values in acres.

Table 3.22
Cleanup Criteria/Figure Matrix by RASS

Cleanup Criteria	Figure			
	RASS 1	RASS 2	RASS 3	RASS 4
Exceeding Soil Metal Content of Reference Area	11,12,13	11	35	44
Soil Metal Statistically Higher Than Reference Area	14	14	36	45
Soil Metal Content Exceeding MASSA Values	15	15	37	46
Areas of Death or Statistically Significant Bioaccumulation	16,17,18	16	38	47
Area of Contamination	19,20,21	19	39	48
Areas Where Soil Metal Content Exceeds STLC or TTLC Values	22	22	40	49

3.5.2 Rationale for Selecting Remediation Area

The analytical process for determining appropriate remedial actions for each RASS on NWS Concord was initiated by identifying and evaluating applicable or relevant and appropriate Federal and State chemical specific requirements under the circumstances of the release or threatened release at the contaminated sites with respect to the soil contamination, possibility for direct contact, migration of contaminated sediments through the surface water pathway, and bioaccumulation (Section 3.3.2). No applicable quantitative Federal or State cleanup standards exist that can be directly related to cleanup of contaminated soils found on the NWS Concord; however, several relevant and appropriate criteria by which cleanup standards could be established do exist.

Both RCRA and CERCLA, amended by SARA, were enacted to protect human health and the environment from the release and the threat of release of the substances detected on Parcels 572, 573, 574, 575, 576, 579D, and 581 of NWS Concord. RCRA and the preamble of the NCP provide that the standards for hazardous waste treatment, storage, and disposal facilities promulgated under RCRA, 40 CFR 264 are consistent with the goals of long term protection of public health and welfare and the environment contained in CERCLA.

Accordingly, these standards may be relevant and appropriate to the release and the threat of the release of hazardous substances on Parcels 572, 573, 574, 575, 576, 579D, and 581 on NWS Concord.

Under 40 CFR 264.228, 264.258, and 264.310, land disposal facilities cannot simply cease operating. Instead, such facilities must "close" so that they do not present a threat to human health or the environment. Closure of a land disposal facility must be accomplished either by (1) removing or decontaminating all waste residues, contaminated subsoils, structures and equipment contaminated with waste, or (2) stabilizing the wastes, capping them, and complying with the post closure requirements of 40 CFR 264.117-264.120, including maintaining a ground-water monitoring system and complying with all other requirements of 40 CFR 264, Subpart F.

Under RCRA, a clean closure would consist of removing or decontaminating all of the waste residues in order to reach background. Normally, background levels are difficult to determine and subject to wide variation. Therefore, two possible criteria were evaluated as a measure of background soil metal concentrations in the area: exceedance of an absolute background concentration as determined from reference areas and soil concentrations that are statistically different from reference areas.

As stated, since both RCRA and CERCLA, as amended by SARA, are designed to control the release and the threat of the release of hazardous substances, the standards for the closure of hazardous waste treatment, storage, and disposal facilities promulgated under RCRA may be relevant and appropriate to determining the remedial action appropriate for NWS Concord. However, it is believed that a site specific approach to determining acceptable levels of removal based upon all routes of exposure and taking into account potential environmental impacts of the potential remedial action is more appropriate. The area of cleanup assuming implementation of each of the criteria is presented in Table 3.21.

3.5.2.1 Zones of Remediation. Recognizing the lack of definitive criteria for clean up of contaminated soils, the importance of the existing habitat, the desirability of minimizing environmental disruption during the potential

remediation process, and the qualitative nature of many environmental evaluations, relevant and appropriate criteria were selected that would result in sufficient environmental clean up while minimizing short term impacts. This process is especially important for RASS's 1 and 2 because of the presence of endangered species on these subsites. This was accomplished by dividing each subsite into zones of active remediation, passive remediation, and monitoring.

Active Remediation. Active remediation would be implemented in those subsites failing the selected remediation criteria. Active remediation includes alternatives that result in positive control/treatment of contaminants. Examples of active remediation include, but are not limited to, excavation and disposal, source isolation by capping, soil washing, soil liming and contaminant immobilization.

Passive Remediation. Passive remediation alternatives would be implemented in two cases. One, for those areas not failing the selected remediation criteria, but which contain contaminant levels statistically higher than reference area levels; and two, in areas on the subsite that fail the selected remediation criteria, but in which mediating factors exist, i.e., presence of endangered species. Passive remediation includes short and long-term monitoring of soil, water, and biota in the affected area. Passive remediation measures are less intrusive than active measures and reflect the significant level of concern over leaving any contamination in the environment, while recognizing the short term impacts of active remediation and the ability of the environment to assimilate some contamination. That is, considering all available information, the impact of actively remediating the contaminated area on the subsite may be more severe than the impacts associated with leaving the contamination in place. Passive remediation will, however, ensure that substantial unanticipated impacts will not result from leaving the contamination in place. Passive remediation is designed to identify problems and trigger active remediation activities if necessary.

Monitoring. The monitoring zone was established in recognition of the fact that contaminants may migrate into presently uncontaminated areas on the subsite and that biotic populations are not constrained by artificial boundaries. The monitoring zone is an area surrounding the contaminated area that will be

used for evaluating the effectiveness of the remediation. Monitoring will be less intensive than in the passive remediation zone and unlike the passive remediation zone, the monitoring zone is not considered a likely candidate for future active remediation.

3.5.2.2 Factors Considered in the Criteria Selection Process. In addition to the quantitative criteria previously discussed (Section 3.3.2), several factors affecting the desirability and scope of a projected remedial action were also identified. These factors are presented in Table 3.23. These factors act as modifiers of the basic quantifiable decision rules.

Source of Contamination to Other Areas. The requirement for a permanent remedial action requires consideration of a factor that may broaden the perspective of an investigation. The nature, mobility, and degree of contamination of the source become considerations if an area may contribute to recontamination from an adjacent or connected site. If an area contributes to the contamination of an adjacent or connected site, more complete active remediation should occur to ensure elimination of future recontamination of adjacent or connected sites.

Precedent. The criteria established for remediation in previous response actions involving similar conditions require consideration.

Wetlands. The requirement to attain applicable or relevant and appropriate standards, requirements, criteria, or limitations established under Federal law and applicable or relevant and appropriate standards, requirements,

Table 3.23

Typical Factors Considered in Selecting Remediation Criteria

Source of Contamination to Other Areas
Precedent
Wetland
Presence of Endangered Species
Topography

criteria, or limitations, promulgated under state environmental or facility siting laws requires consideration of Federal laws, regulations, and executive orders and State laws and promulgated regulations which govern activities in wetlands. Potentially applicable or relevant and appropriate Federal requirements include the Clean Water Act, and regulations promulgated thereunder for the discharge of pollutants into the waters of the United States, 33 CFR 320-329, and Executive Orders 11,990 and 11,988. Potentially applicable or relevant and appropriate state requirements include the California Water Code, and regulations promulgated thereunder, and the California Public Resources Code. If an area were to be remediated and/or restored by depositing fill material in wetlands, such laws, regulations, and executive orders may be applicable or relevant and appropriate.

Presence of Endangered Species. The requirement to attain applicable or relevant and appropriate standards, requirements, criteria, or limitations established under Federal law and applicable or relevant and appropriate standards, requirements, criteria, or limitations promulgated under State environmental or facility siting laws requires consideration of Federal laws, regulations, and executive orders and State laws and regulations which govern the protection of endangered species. Potentially applicable Federal laws and regulations include the Endangered Species Act and regulations promulgated thereunder, if the release and the threat of release of hazardous substances or the response to the release or the threat of release were to take endangered species, jeopardize the continued existence of endangered species, or result in the destruction or adverse modification of the critical habitat of endangered species.

Topography. Because surface movement of contamination may be expected to follow topographic features, land forms such as tidal creeks are important in determining the need for remedial action. The mechanism of remedial actions is also related to topography, e.g., the ability of heavy equipment to work in wetland soils.

3.5.3 Selected Cleanup Criteria by RASS.

3.5.3.1 Criteria for RASS 1. RASS 1 includes brackish water wetlands, uplands, and a transition zone. The presence of endangered species and candidates for listing as endangered species of RASS 1 has been documented. The criteria and factors identified for evaluating the appropriate cleanup criteria for RASS 1 are shown on Plate 3.2.

In response to the "clean closure" requirements of RCRA, the initial criterion evaluated for RASS 1 was return to reference soil metal concentrations, where background was defined as the highest value observed in selected reference areas (BK 116 and 133). Investigations of soil metal contents in RASS 1 and the reference area indicated that under this criterion 85.42 acres would require cleanup. However, the soil metal content was highly variable, making the "return to background" criterion difficult to interpret and implement. In order to account for this variability, the "statistically above reference" criterion was evaluated. Under the "statistically above reference" criteria, 19.24 acres would require cleanup.

In reviewing the factors impacting the selection of criteria for RASS 1, it was noted that RASS 1 contained both wetlands and habitat for endangered species as well as for candidates for listing as endangered species. Taking these factors and the short term impacts resulting from contaminant removal into account, application of professional judgement indicated that a less stringent criteria would provide adequate overall protection of the public health and the environment while balancing short and long term impacts.

A criterion based on removal of contamination exceeding TTLC/STLC values was then investigated. Implementation of this criterion would require remediation of 15.40 acres. Qualitative balancing of short term and long term impacts associated with implementation of this criteria indicated that a further reduction of the cleanup criteria was in order. The magnitude of this reduction was accomplished by reviewing the results of soil metal analyses, plant and animal bioaccumulation data, soil invertebrate abundance and diversity data, plant and animal mortality data, topographic and hydrologic characteristics, extent of barren areas, and extent of degraded habitat. Of particular

POTENTIAL CRITERIA

Contaminant Content of Soils
- Greater Than Highest Reference Level
- *Statistically Above Reference Level*
- Exceeding MASSA
- *Exceeding TTLC/STLC**
- Exceeding EP
- *Low pH*

Direct Contact
- Human Ingestion
  - *Exceeds California DOHS Recommendations*
  - *Soil Ingestion Standards*
- Bioaccumulation Plants
  - *Statistically Above Reference Area*
  - Critical Content
  - FDA Standards
- Bioaccumulation Animals
  - *Statistically Above Reference Area*
  - FDA Standards

Indirect Contact
- *Ambient Water Quality Standards*
- Drinking Water Standards
- California Applied Action Levels

Habitat Quality
- *Death of Plants or Animals*
- *Barren Areas**
- *Undesirable Change in Biotic Composition*

RASS 1

POTENTIAL FACTORS

Source Contamination to Other Areas

Precedent

Wetland

Presence of Endangered Species

Topography

* Basis for decision rule. Criteria/factors in italics were used in the evaluation process.

Plate 3.2. Criteria and factors used in selecting active remediation criteria for RASS 1.

importance was the animal bioaccumulation data, which indicated the accumulation of significant body burdens of cadmium, lead, and selenium.

Because of the nature of RASS 1 (wetlands and the presence of endangered species), consideration was given to remediating only barren areas. Evaluation of this criterion revealed that substantial areas containing high concentrations of metals and showing signs of significant bioaccumulation would remain.

The barren area criterion, resulting in remediation of 1.03 acres, was discarded as being insufficient to adequately protect the public health or the environment.

Consideration of the available criteria and factors resulted in the decision to divide the RASS into three zones of remediation: active remediation zone, passive remediation zone, and monitoring zone. The selected composite criteria for remediation of RASS 1 is stated as follows.

1. Active remediation of those areas in which the soil metal content exceeds the TTLC/STLC criterion, modified as follows.

a. Reduce the area of active remediation, accounting for topography and the presence of endangered species, to the area in the easterly most portion of the RASS. Thus, leaving approximately seven acres of wetland that exceed the TTLC/STLC criterion undisturbed.

b. Increase the area of active remediation to include those barren areas not contained within the boundaries of the TTLC/STLC criterion.

2. Passive remediation, extensive monitoring with the potential for future active remediation, in areas of contamination not actively remediated.

3. Monitoring, less intensively than in the passive remediation zone, in the remainder of the RASS.

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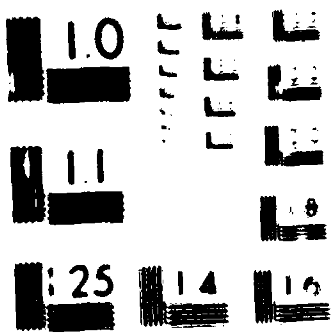
WEAPONS STATION C..(U) ARMY ENGINEER WATERWAYS
EXPERIMENT STATION VICKSBURG MS ENVIR..
UNCLASSIFIED M J CULLINANE ET AL. SEP 88 F/G 24/3 NL


1.0
1.1
1.25
1.4
1.6

Implementation of the selected criteria results in the following areas of remediation and monitoring as shown in Figures 23, 24, and 25 (Lee, Cullinane, O'Neil 1988)

Active Remediation	9.03 acres
Passive Remediation	23.01 acres
Monitoring	177.74 acres

3.5.3.2 Criteria for RASS 2. RASS 2 included brackish water wetlands, uplands, and a transition zone. The presence of endangered species and candidates for listing as endangered species on RASS 2 has been documented. The criteria and factors identified for evaluating the appropriate cleanup criteria for RASS 2 are shown on Plate 3.3.

In response to the "clean closure" requirements of RCRA, the initial criteria evaluated for RASS 2 was return to reference soil metal concentrations, where background was defined as the highest value observed in selected reference areas (BK 113 and BK 116). Investigations of soil metal contents in RASS 2 and the reference area indicated that under this criterion 11.58 acres would require cleanup. However, the soil metal content was highly variable, making the "return to background" criteria difficult to interpret and implement. In order to account for this variability, the "return to background" criteria was replaced with a criterion requiring that contamination "statistically above reference areas" be removed. Under the "statistically above reference area" criteria, 2.44 acres would require cleanup.

In reviewing the factors impacting the selection of criteria for RASS 2, it was noted that RASS 2 contained both wetlands and habitat for endangered species. Taking these factors and the short term impacts resulting from contaminant removal into account, application of professional judgement indicated that a less stringent criterion would provide adequate overall protection of the public health and the environment by balancing short and long term impacts.

A criterion based on removal of contamination exceeding TTLC/STLC values was then investigated. Implementation of this criteria would require remediation of 3.75 acres. Qualitative balancing of short term and long term impacts associated with implementation of this criterion indicated that the TTLC/STLC

POTENTIAL CRITERIA

Contaminant Content of Soils
- Greater Than Highest Reference Level
- *Statistically Above Reference Level*
- Exceeding MASSA
- *Exceeding TTLC/STLC**
- Exceeding EP
- Low pH

Direct Contact
- Human Ingestion
  - *Exceeds California DOHS Recommendations*
  - *Soil Ingestion Standards*
- Bioaccumulation Plants
  - *Statistically Above Reference Area*
  - Critical Content
  - FDA Standards
- Bioaccumulation Animals
  - *Statistically Above Reference Area*
  - FDA Standards

Indirect Contact
- *Ambient Water Quality Standards*
- Drinking Water Standards
- California Applied Action Levels

Habitat Quality
- *Death of Plants or Animals*
- *Barren Areas**
- *Undesirable Change in Biotic Composition*

RASS 2

POTENTIAL FACTORS

Source Contamination to Other Areas

Precedent

Wetland

Presence of Endangered Species

Topography

* Basis for decision rule. Criteria/factors in italics were used in the evaluation process

Plate 3.3. Criteria and factors used in selecting active remediation criteria for RASS 2.

cleanup criteria provides for protection of the public health and environment. This assessment was confirmed by reviewing the results of soil metal analyses, plant and animal bioaccumulation data, plant and animal mortality data, topographic and hydrologic characteristics, extent of barren areas, and extent of degraded habitat. Of particular interest was the animal bioaccumulation data, which indicated the accumulation of significant body burdens of cadmium, lead, and selenium.

Because of the nature of RASS 2 (wetlands and the presence of endangered species), consideration was given to remediating only barren areas. Evaluation of this criterion revealed that substantial areas containing high concentrations of metals and showing signs of significant bioaccumulation would remain. The barren area criterion was discarded as being insufficient to adequately protect the public health or the environment.

Consideration of the available criteria and factors resulted in the decision to divide the RASS into three zones of remediation: active remediation zone, passive remediation zone, and monitoring zone. The selected composite criteria for remediation of RASS 2 is stated as follows.

1. Active remediation of those areas in which the soil metal content exceeds the TTLC/STLC criterion. Increase the area of active remediation to include those barren areas not contained within the boundaries of the TTLC/STLC criterion.

2. Passive remediation, extensive monitoring with the potential for future active remediation, in areas of contamination not actively remediated.

3. Monitoring, less intensively than in the passive remediation zone, in the remainder of the RASS.

Implementation of this final criteria results in the following areas of remediation and monitoring as shown in Figure 23 (Lee, Cullinane, and O'Neil 1988).

Active Remediation	4.17 acres
Passive Remediation	0.94 acres
Monitoring	8.21 acres

3.5.3.3 Criteria for RASS 3. RASS 3 includes freshwater wetlands, uplands, intermittent and perennial streams, and a transition zone. Endangered species and candidates for listing as endangered species on RASS 3 have not been documented. Although RASS 3 contains significant wetland area, these freshwater wetlands are not considered to be as sensitive as those found in RASS 1 and RASS 2 because of the absence of protected species. Moreover, RASS 3 was identified as a source or pathway for migration of contamination of lead, zinc, and cadmium onto RASS 2 and potentially RASS 1. The criteria and factors identified for evaluating the appropriate cleanup criteria for RASS 3 are shown on Plate 3.4.

In response to the "clean closure" requirements for RCRA, the initial criteria evaluated for RASS 3 was return to reference soil metal concentrations, where background was defined as the highest value observed in selected reference areas (BK133 and BK116). Investigations of soil metal contents in RASS 3 and the reference area indicated that under this criterion 8.66 acres require clean up. However, the soil metal content was highly variable, making the "return to background" criteria difficult to interpret and implement. In order to account for this variability, the "return to background" criteria was replaced with the criteria that contamination "statistically above reference areas" would be removed. Under the "statistically above reference area" criteria, 4.58 acres would require cleanup.

In reviewing the factors impacting the selection of criteria for RASS 3, it was noted that RASS 3 was a source of contamination for RASS 1 and RASS 2. In addition, the wetlands and habitat provided by RASS 3 are believed to be relatively resilient to intrusive remedial action and are not inhabited by endangered species. Because of these factors, the short term impacts resulting from contaminant removal are expected to be less than the anticipated short term impacts in RASS 1 and RASS 2. Therefore, application of the stringent "statistically above reference" criteria appeared appropriate. This criteria

POTENTIAL CRITERIA

Contaminant Content of Soils
- Greater Than Highest Reference Level
- *Statistically Above Reference Level**
- Exceeding MASSA
- *Exceeding TTLC/STLC**
- Exceeding EP
- Low pH

Direct Contact
- Human Ingestion
  - *Exceeds California DOHS Recommendations*
  - *Soil Ingestion Standards*
- Bioaccumulation Plants
  - *Statistically Above Reference Area*
  - Critical Content
  - FDA Standards
- Bioaccumulation Animals
  - *Statistically Above Reference Area*
  - FDA Standards

Indirect Contact
- *Ambient Water Quality Standards*
- Drinking Water Standards
- California Applied Action Levels

Habitat Quality
- Death of Plants or Animals
- Barren Areas
- Undesirable Change in Biotic Composition

RASS 3

POTENTIAL FACTORS

Source Contamination to Other Areas

Precedent

Wetland

Presence of Endangered Species

Topography

* Basis for decision rule. Criteria/factors in italics were used in the evaluation process.

Plate 3.4. Criteria and factors used in selecting active remediation criteria for RASS 3.

will provide for the overall protection of the public health and the environment by balancing short and long term impacts.

Consideration of the available criteria and factors resulted in the decision to divide the RASS into three zones of remediation: active remediation zone, passive remediation zone, and monitoring zone. The selected composite criteria for remediation of RASS 3 is stated as follows.

1. Active remediation of those areas in which the soil metal content exceeds either the TTLC/STLC criterion or the statistically above reference area criterion.

2. Passive remediation, extensive monitoring with the potential for future active remediation, in areas of contamination not actively remediated.

3. Monitoring, less intensively than in the passive remediation zone, in the remainder of the RASS.

Implementation of this final criteria results in the following areas of remediation and monitoring as shown in Figure [illegible] (Lee, Cullinane, and O'Neil 1988).

Active Remediation	4.6[illegible] acres
Passive Remediation	[illegible] acres
Monitoring	63.54 acres

3.5.3.4 Criteria for RASS 4. RASS 4 includes uplands, freshwater wetlands, and a transition zone. Endangered species and candidates for listing as endangered species have not been documented on RASS 4. Although RASS 4 is primarily upland, a small freshwater wetland is located on the eastern edge of this RASS. The criteria and factors identified for evaluating the appropriate cleanup criteria for RASS 4 are shown on Plate 3.5.

In response to the "clean closure" requirements for RCRA, the initial criteria evaluated for RASS 4 was return to reference soil metal concentrations, where background was defined as the highest value observed in selected remote

POTENTIAL CRITERIA

Contaminant Content of Soils
- Greater Than Highest Reference Level
- *Statistically Above Reference Level*
- Exceeding MASSA
- *Exceeding TTLC/STLC**
- Exceeding EP
- *Low pH**

Direct Contact
- Human Ingestion
  - *Exceeds California DOHS Recommendations*
  - *Soil Ingestion Standards*
- Bioaccumulation Plants
  - *Statistically Above Reference Area*
  - Critical Content
  - FDA Standards
- Bioaccumulation Animals
  - *Statistically Above Reference Area*
  - FDA Standards

Indirect Contact
- *Ambient Water Quality Standards*
- Drinking Water Standards
- California Applied Action Levels

Habitat Quality
- *Death of Plants or Animals*
- Barren Areas
- Undesirable Change in Biotic Composition

RASS 4

POTENTIAL FACTORS

Source Contamination to Other Areas

Precedent

Wetland

Presence of Endangered Species

Topography

* Basis for decision rule. Criteria/factors in italics were used in the evaluation process.

Plate 3.5. Criteria and factors used for selecting active remediation criteria for RASS 4.

reference areas (BK 133 and BK 116). Investigations of soil metal contents in RASS 4 and the reference area, indicated that under this criterion [illegible] acres would require remediation. However, the soil metal content was highly variable, making the "return to reference area" criteria difficult to interpret and implement. In order to account for this variability, the "return to background" criteria was replaced with the criteria that contamination "statistically above reference areas" would be removed. Under the "statistically above reference area" criteria, [illegible] acres would require cleanup.

In reviewing the factors impacting the selection of criteria for RASS 4, it was noted that RASS 4 is primarily upland with a relatively small area of freshwater wetland and associated transition zone located along the eastern boundary of the RASS. RASS 4 is not known to provide habitat for endangered species or candidates for listing as endangered species. The wetlands and habitat provided by RASS 4 are believed to be relatively resilient to intrusive remedial action.

Soils data indicated that a large portion of RASS 4 had low pH values that could contribute to the mobility of the metals found in the RASS.

Consideration was given to a less stringent standard than the significantly above reference area criteria. Review of the TTLC STLC data indicated that only a relatively small portion of the RASS exceeded these criteria with the remaining larger portion having soil metal contents between the statistically above reference area criteria and the TTLC STLC criteria.

Consideration was given to actively remediating only those areas of low soil pH. Evaluation of this criterion revealed that substantial areas containing high concentrations of metals indicating that a potential bioaccumulation would remain. The low pH criterion was discarded as being insufficient to adequately protect the public health or the environment.

Consideration of the available criteria and factors resulted in the decision to divide the RASS into three zones of remediation: an active remediation zone, a passive remediation zone, and a monitoring zone. The selected composite criteria for remediation of RASS 4 is stated as follows.

1. Active remediation of those areas in which the soil metal content exceeds either the TTLC/STLC criterion or the low pH criterion.

2. Passive remediation, extensive monitoring with the potential for future active remediation, in areas of contamination not actively remediated.

3. Monitoring, less intensively than in the passive remediation zone, in the remainder of the RASS.

Implementation of this final criteria results in the following areas of remediation and monitoring as shown on Figure 51 (Lee, Cullinane, and O'Neil 1988).

Active Remediation	0.87 acres
Passive Remediation	0.54 acres
Monitoring	11.88 acres

3.5.4. Summary of Selected Clean up Criteria

The extent of active and passive remediation for each RASS is presented in Table 3.24.

Table 3.24

Remediation Area for Selected Decision Criteria

	Passive Remed. Action in Non-Wetland	Passive Remed. Action in Wetland	Total Passive Remediation	Active Remed. Action in Non-Wetland	Active Remed. Action in Wetland	Total Active Remediation
Pass 1						
572 N	0.05	22.27	22.32	0.16	8.87	9.03
571 N	--	0.06	0.06	--	--	--
571 SF	--	0.02	0.02	--	--	--
571 SP	--	--	--	--	--	--
CC	--	--	--	--	--	--
CC SF	--	--	--	--	--	--
CC SP	--	--	--	--	--	--
Other N	--	0.01	0.01	--	--	--
Other SF	--	--	--	--	--	--
Other SP	--	--	--	--	--	--
Stream	--	0.60	0.60	--	--	--
SUBTOTAL	0.05	22.96	23.01	0.16	8.87	9.03
Pass 2						
572 N	--	0.67	0.67	1.11	1.43	2.54
572 SF	0.27	0.27	0.27	1.40	0.20	1.60
572 SP	--	--	--	0.03	--	0.03
SUBTOTAL	0.27	0.94	0.94	2.54	1.63	4.17

(continued)

Table 3.24 (Concluded)

	Passive Remed. Action in Non-Wetland	Passive Remed. Action in Wetland	Total Passive Remediation	Active Remed. Action in Non-wetland	Active Remed. Action in Wetland	Total Active Remediation
RASS 3						
573 Other SP	--	--	--	--	--	--
573 Other N	0.02	--	[illegible]	[illegible]	--	0.03
573 Other SF	--	--	--	--	--	--
573 SP	--	--	--	--	--	--
573 N	--	0.01	[illegible]	[illegible]	[illegible]	[illegible]
573 SF	--	--	--	--	--	--
574 SP	--	--	--	[illegible]	--	[illegible]
574 N	0.05	0.32	[illegible]	[illegible]	[illegible]	[illegible]
574 SF	--	--	--	--	--	--
575 SP	--	--	--	--	--	--
575 N	--	--	--	[illegible]	[illegible]	[illegible]
575 SF	--	--	--	--	[illegible]	0.01
576 SF	0.01	--	[illegible]	[illegible]	[illegible]	[illegible]
576 N	0.02	--	[illegible]	--	[illegible]	[illegible]
576 SN	0.04	--	[illegible]	[illegible]	[illegible]	[illegible]
579D-Other-N	--	--	--	--	--	[illegible]
579D-N	0.48	--	[illegible]	Trace	Trace	Trace
579D-SN	0.04	--	[illegible]	--	[illegible]	[illegible]
579D-CP	--	--	--	[illegible]	[illegible]	[illegible]
579D-CP-SN	[illegible]	--	[illegible]	Trace	--	Trace
SUBTOTAL	0.68	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
RASS 5						
581-N	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
581-N-Other-N	--	[illegible]	[illegible]	--	--	[illegible]
SUBTOTAL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
TOTAL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

All areas in acres.

4.0 SCREENING OF REMEDIAL ACTION TECHNOLOGIES

The first step in meeting the action levels described in Section 3.4 was to develop generalized response actions. These general response actions are used as the basis for technology selection and development of the detailed alternatives presented in Section 5 of this feasibility study. Guidance on general responses to threats caused by contaminated soils is provided in Section 300.68(j)(3) of the NCP. General responses include actions to remove, treat, or contain the soil to reduce the potential for hazardous substances or pollutants or contaminants to contaminate other media and to reduce or eliminate the potential for such substances to be inhaled, absorbed, or ingested. The general response actions and associated technologies selected for evaluation at NWS Concord are presented in Table 4.1.

Section 121 of CERCLA, as amended, also provides guidance on the identification and evaluation of remedial action alternatives and technologies. Section 121(b)(1) of CERCLA, as amended, requires selection of a remedial action that is protective of human health and the environment, that is cost effective, and that utilizes permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. Section 121(b)(1) of SARA states that "remedial actions in which treatment which permanently and significantly reduces the volume, toxicity, or mobility of the hazardous substances, pollutants, and contaminants is a principal element, are to be preferred over remedial actions not involving such treatment." Section 300.68(h)(2)(v) of the NCP requires the evaluation of waste biodegradation, destruction, or other advanced, innovative, or alternative technologies to determine their potential applicability for reliably minimizing present or future threats to public health or welfare or the environment.

The second step in the development of remedial alternatives is to define and screen technologies that are applicable to the general response actions that may be appropriate to the specific site under study (USEPA 1985).

The individual technologies are assembled and screened through the use of engineering judgement, qualitative comparisons, and previous experience with

Table 4.1

General Response Actions and Associated Remediation Technologies

General Response	Associated Technology
Containment	Surface Water Diversion and/or Collection, Surface Sealing and Capping, Grading and Revegetation, Containment Barriers, Hydraulic Barriers, Bottom Sealing, Withdrawal Well Networks, Flood Proofing, Subsurface Collection Drains, Vitrification
Off Site Disposal	Excavation and Disposal, Recycle/Reuse, Waste Minimization
On Site Disposal	Excavation and Disposal, Recycle/Reuse, Waste Minimization
Off Site Treatment	Incineration, Contaminant Immobilization, Biological Treatment, Soil Washing, Waste Minimization
On Site Treatment	Incineration, Contaminant Immobilization, In Situ Contaminant Immobilization, Biological Treatment, Soil Washing, Soil Flushing, Ground Water and Leachate Treatment, Permeable Treatment Beds, Waste Minimization, In Situ Heating, In Situ Freezing
No Action	No Remedial Action

the application of the individual technologies to other cleanup sites. Inappropriate, infeasible, and unreliable technologies are discarded from further consideration. The US EPA (1982, 1985) identified major categories and subcategories of technologies with potential application as remedial actions at hazardous waste sites. The technologies which are deemed to have applicability to the various contaminated sites at NWS Concord are summarized in Section 4.2.

The applicability of individual remedial technologies to a particular site is determined by the nature of the contaminant problems and the important migration pathways at the specific site. As noted in several previous studies, Ecology and Environmental (1983), Anderson Geotechnical (1984), Lee et al. (1985), and Lee et al. (1986, 1988), the contaminants of concern at NWS Concord are heavy metals, primarily arsenic, lead, cadmium, zinc, copper and selenium. The primary pathway of off site contaminant migration is transport

via surface water runoff and erosion processes with subsequent deposition along natural water courses and low lying areas. Secondary pathways of contaminant transport include release of contaminants from the site by wind or direct contact with the site. Leaching of contaminants from the site by surface water infiltration into the groundwater or direct contact with groundwater have not been identified as major migration pathways.

The analysis of treatment technologies emphasized the identification and evaluation of those technologies that fall within the requirements of CERCLA, as amended, which require consideration of remedial actions that use permanent solutions. While continuing to require cost effective remedies which protect the human health and the environment, CERCLA, as amended, places a greater emphasis on the long-term protectiveness and reliability of the remedial actions.

4.1 Evaluation of Remediation Technologies

A brief description and evaluation of the remedial action technologies described in Table 4.1 are presented below.

4.1.1 Recycle/Reuse. Sections 300.68(e)(2)(viii) and 300.68(h)(2)(v) of the NCP require that the potential for recycle/reuse of wastes be evaluated. This requirement applies more to the traditional concept of a hazardous waste dump site rather than to the conditions found at NWS Concord, i.e., release of hazardous substances onto a soil media. The threat at all subsites evaluated in this feasibility study is caused by the contamination of surface soil. In addition, the number of contaminants and the relatively low concentrations make recycle/recovery impractical. At the present time, there is no known potential for the recycling/reuse of contaminated soil; however, technologies are available, at least in theory, which could be used to extract the metals from the soil with subsequent potential for recovery. These technologies are evaluated in the section on soil washing (Section 4.1.13). Therefore, the concept of applying a direct recycle/reuse technology was eliminated from further consideration. However, recovery of metal contaminants was indirectly considered as a part of the technology evaluation process.

4.1.2 Waste Minimization. Section 300.68(h)(2)(v) of the NCP requires evaluation of the potential for application of waste minimization technologies. Since the threat at the NWS Concord sites evaluated in this feasibility study is associated with the presence of existing areas of contaminated soils, waste minimization technology is inappropriate. However, the amount of contaminated materials to be handled in any proposed remedial action will be minimized through application of the site specific action levels that minimize the quantity of materials to be handled consistent with protection of the public health or welfare or the environment.

4.1.3 Surface Sealing and Capping. Surface sealing and capping is the process by which waste disposal sites are covered to prevent surface water infiltration, control erosion, and isolate and contain contaminated materials. A variety of impermeable cover materials and sealing techniques is available for such purposes. The choice of sealing and capping material and method of application is dictated by site specific factors such as local availability and cost of cover materials, desired function of cover materials, the nature of the waste being covered, local climate and hydrogeology, and projected future use of the site.

Soils used for capping uncontrolled waste sites should be relatively impermeable and erosion resistant. Fine grained soils such as clays and silty clays have low permeability values and are therefore best suited for capping purposes. However, these fine grained materials tend to be easily eroded by wind and water. Blending of soil types can be used to enhance the permeability and erodibility characteristics of capping soils. Cover soil additives such as cements, lime and/or flyash, bitumen (emulsified asphalt or tar), chemical stabilizers (dispersants and swell reducers), and bentonite have also been used to enhance cover soils.

Membrane technologies have also been used as surface treatments. Portland and bituminous concretes and mortars can be mixed and spread over well compacted bases to cover and seal the disposal site. Sprayed bitumen membranes are also available. Synthetic membranes include cover and liner materials made from polyvinyl chloride (PVC), chlorinated polyethylene (CPC), high density polyethylene (HDPE), ethylene propylene rubber, butyl rubber, hypalon, neoprene,

and elasticized polyolefin. The use of synthetic liners serve to reduce the profile of the cover system.

Surface sealing and capping technology directly addresses the surface water migration and direct contact pathway. Since this pathway is a primary concern at the NWS Concord site, the technology will be evaluated further during the alternative screening process.

4.1.4 Grading and Revegetation. Grading is a general term used to describe techniques to reshape the surface of a site in order to manage surface water infiltration and runoff while controlling erosion. Revegetation decreases erosion by wind and water and contributes to the development of a naturally fertile and stable surface environment. Grading schemes for management of runoff, infiltration, and erosion are usually implemented in conjunction with surface sealing and capping technologies and may be an integral part of revegetation schemes. Slopes of at least 5 percent are recommended as sufficient to decrease infiltration without risking soil erosion. Where off site transport of contaminated soil due to water erosion is a major consideration, the length of graded slopes should be minimized. Grading and revegetation are routinely applied to upland sites; however, the general concept can be expanded to include marsh restoration as a remedial action alternative.

Remedial alternatives that incorporate leaving the waste materials on site should include a grading and revegetation scheme. Alternatives that incorporate excavation and off site disposal of contaminated materials may include grading and revegetation as part of a marsh restoration scheme. In any event, grading and revegetation technologies have application at the NWS Concord site and will be evaluated further in the alternative screening process.

4.1.5 Surface Water Diversion and/or Collection. Surface water diversion and collection structures are used to provide either short-term or permanent measures to hydrologically isolate waste disposal sites from surface inputs. Surface runoff can be managed so that it does not contribute to leachate generation or erosion of cover materials. Conventional measures used to control flooding, surface water infiltration, and off site erosive transport of contaminated sediments and debris include: dikes and berms, ditches,

diversions, and waterways; terraces and benches; chutes and downpipes; levees; seepage basins; and sedimentation basins. At any given disposal site, the most effective method of managing surface flow may be a combination of the above techniques. The selection of individual techniques depends on the size and topography of the site, local climate and hydrology, and soil characteristics. More specifically, the length and steepness of slopes, the frequency and intensity of rainfall, and soil permeability, erodibility, and fertility all affect the choice of type and number of individual structures to be included at a particular site.

Contaminant migration resulting from surface water runoff is identified as a major concern at the NWS Concord site. Since surface water diversion and collection technologies directly address this problem, these technologies will be evaluated for incorporation into remedial action alternatives during the alternative screening process.

4.1.6 <u>Containment Barriers.</u> Containment barriers include slurry trenches, grout curtains, sheet piling, or other vertical barriers of low permeability materials. Three configurations of barriers are possible: upgradient of the source, downgradient of the source, and completely around the source. Upgradient barriers are designed to divert ground water around the source of contamination and thereby reduce the volume of water which contacts the waste. Downgradient barriers are designed to control movement of the contaminant plume so that it can be captured by a drain or withdrawal wells. Barriers around contamination sources are designed to completely isolate the source. The appropriate barrier configuration depends on the hydrogeological characteristics of the specific site. Performance of containment barriers depends primarily on how well the barrier can be anchored (keyed) into underlying impermeable materials. In the absence of underlying impermeable materials, hanging barriers can be utilized. If contaminants have a specific gravity greater than ground water, hanging barriers are not effective in preventing contaminant migration. Since in either case there is always the potential for flow underneath the barrier, barriers may be used in conjunction with withdrawal wells to prevent future migration of contaminants.

Containment barriers are generally used to address problems associated with contaminants leaching into the groundwater underlying a hazardous substance disposal site. Since the groundwater migration pathway has not been identified as a major concern at the NWS Concord site, containment barriers will not be considered during the alternative development process.

4.1.7 Hydraulic Barriers. Hydraulic barriers are pumping and/or injection well systems that divert the flow of ground water. Such systems can be a simple single pumping well which creates a cone of depression and draws the contaminant plume toward the well, or a complex series of pumping wells and injection wells for creating large scale cones of depression surrounded by ground-water mounds. In either case the withdrawn ground water is treated and either discharged on the surface or injected into the aquifer.

Hydraulic barriers are generally used to address problems associated with contaminants leaching into groundwaters underlying a waste-disposal site. Since the groundwater migration pathway has not been identified as a major concern at the NWS Concord site, hydraulic barriers will not be considered during the alternative development process.

4.1.8 Excavation and Disposal. Excavation and disposal involves the removal of hazardous substances from their present location to a better engineered or environmentally less sensitive area. Excavation is a common technique used in earth moving projects. It is widely used to move solids and thickened sludge materials; however, it is not well suited for removal of materials with low solids content. Where off site treatment methods are to be used for landfilled wastes, excavation and transportation of the hazardous substances will be required.

Excavation can be accomplished by a variety of mechanical means. Typical excavation equipment used for remedial actions includes draglines and backhoes. The nature of some sites at NWS Concord, i.e., wetland, may preclude the use of these traditional excavation techniques. In such cases, hazardous substances can be removed by dredging. Several types of dredges are commonly used, including hydraulic, pneumatic, and mechanical dredges.

Excavation and disposal would remove contaminated materials from the site and prevent continued migration of contamination. This technology would provide a major improvement. However, it would probably not be cost effective for removal of all contaminated material, i.e., removal of low levels of contaminants that have already migrated from major spill areas. In addition, excavation technologies can be environmentally disruptive in sensitive areas such as wetlands.

Several disposal options may be implemented in association with excavation technologies, including: 1) removal to existing permitted facilities, 2) removal to an off site permitted facility constructed specifically for NWS Concord wastes, 3) removal to an on site disposal facility constructed to meet appropriate standards, 4) chemical stabilization and disposal on the existing waste site, or disposal in on- or off-site landfills, and 5) soil washing followed by disposal on the existing contaminated site or in on- or off-site landfills.

Excavation and disposal technologies also require implementation of waste transportation techniques. Transportation requirements are usually satisfied by the use of plastic lined and covered dump trucks. Typical truck capacities range from 15 to 30 cubic yards. Care must be taken to ensure that the transportation of hazardous substances does not result in spread of contamination along the route of travel. Fugitive dust control is extremely important in both the excavation and transportation process.

Since the excavation and disposal technology directly addresses the problem of contaminant migration and could potentially provide a major improvement in site conditions, it will be evaluated further as a candidate element in a remedial action alternative.

4.1.9 Biological Treatment. Biological treatment, biodegradation, is a technique for treating zones of organic contamination by microbial action (USEPA 1985). Inorganic compounds, including heavy metals, as well as some organic compounds (especially those containing a benzene ring), are not amenable to biodegradation. The most common application of bioreclamation technology is the in situ restoration of contaminated ground water or surface soils.

Bioreclamation treats dissolved and suspended compounds in ground water, as well as contaminants sorbed on the soil matrix. The microbes used in bioreclamation may respire aerobically or anaerobically; aerobic processes require a source of oxygen, while anaerobic processes may require the addition of nitrate or sulfate for respiration. A nutrient source is usually necessary. The contaminated materials may be left in place, while oxygen, nitrate or sulfate, and a nutrient solution are applied to the zone of contamination. Optional withdrawal wells downgradient of the zone of contamination remove leachate for additional treatment (if necessary), followed by surface disposal or reinjection upgradient of the site. Treatment would continue until allowable concentrations of contaminants within the zone of contamination are achieved. The potential success of this method of reclamation cannot be predicted without performing laboratory and pilot-scale testing at the site.

In situ bioreclamation reduces or eliminates hazardous materials in the waste zone, surrounding soils, and the ground-water plume. Little or no disturbance of the waste zone would be required, thus minimizing the safety risks inherent in the excavation methods.

Although research has shown some success in the biodegradation of organic contaminants in soils and ground water, heavy metals and arsenic are not subject to biodegradation. Therefore, biodegradation of the wastes and contaminated soils is not suitable as the remedy at the NWS Concord site.

4.1.10 Detoxification. Detoxification degrades or otherwise reduces the toxicity of contaminants by chemical means (USEPA 1985). In situ application of detoxification technology has been proposed as a means of addressing contaminant migration. Both inorganic and organic contaminants may be treated. Treatment methods include neutralization, hydrolysis, oxidation/reduction, enzymatic degradation, and permeable treatment beds, and are directed to specific chemical contaminants.

Some of the chemical agents used in detoxification are pollutants themselves or yield toxic byproducts. In situ detoxification provides permanent elimination of the original contamination. Detoxification is applicable as an in situ treatment method only when one or a very few contaminants are of concern.

Detoxification as is not considered an appropriate technology for application at NWS Concord. However, similar concepts are used for the soil washing and soil flushing technologies which are considered to be appropriate for further evaluation.

4.1.11 Vitrification. This technology uses joule (electrical current) heating to convert a contaminated soil mass into durable glass, and to pyrolize waste materials (USEPA 1985). In-situ vitrification is applicable to a wide range of waste materials and contaminants, including organics and heavy metals. Volatile gases released during the heating process are trapped in an off-gas hood for treatment and release.

This method requires the consumption of large amounts of energy, depending on the heat loss experienced at the site. High soil moisture (which exists at the NWS Concord site) significantly increases the heat energy requirement. A contaminated off-gas stream is created which must be captured and treated for release.

The waste material and contaminated soils would be immobilized permanently, preventing migration of contamination in the groundwater. The solidified mass also would be stable during flooding. The safety risks inherent in excavation would be avoided.

Previous studies and experience suggest that in-situ vitrification is practical only at shallow depths (approximately 15 feet or less) and low soil moisture contents (USEPA 1983b). The glassified soils and pyrolized wastes would be reliably stabilized or detoxified, and would not require long-term source isolation. Those contaminated soils not in the vitrification zone and not otherwise treated would remain a source of contamination.

Because of site specific characteristics and the environmentally sensitive nature of a large portion of the contaminated areas at NWS Concord, in situ vitrification is not considered for use in developing remedial action alternatives.

4.1.12 Soil Flushing. Both organic and inorganic contaminants can be extracted from soils by flushing water, aqueous acids/bases, and complexing agents through the soil mass (USEPA 1985). In situ soil flushing is similar to solution mining techniques that have been used commercially for several years. In situ soil flushing involves the injection of the flushing agent directly into the saturated soils, or surface ponding above unsaturated soils. Ground water withdrawal is required to recover the contaminated flushing agent and provide hydraulic isolation. Contaminated flushing agent is treated and recycled or disposed in an appropriate manner. Treatment and recycling is usually necessary if the process is to be economically viable. In situ soil flushing may have the potential to remove contamination from the NWS Concord site.

The flushing agents may be pollutants themselves, and complete recovery of the flushing agent may be difficult. The contaminated flushing agent, or the elutriate recovered from a recycling operation, would be a toxic effluent stream requiring treatment or disposal.

In situ soil flushing would provide treatment for the contaminated soils. The safety risks inherent in excavation would be avoided. The consequences of catastrophic contaminant release due to high tides or flooding would be substantially reduced.

The nature of the soils found at NWS Concord appears to preclude the use of effective flushing agent recovery systems. This along with the random nature of contamination would make implementation of in situ soil flushing a doubtful technology for application at NWS Concord. However, because of the emphasis on alternative treatment technologies, an alternative using this technology will be developed for the initial screening process.

4.1.13 Soil Washing. Soil washing is an extraction technique in which the contaminants are literally washed from the soil with a suitable solvent such as water, or other aqueous or non-aqueous solution. Soil washing is similar to soil flushing with the exception that soil washing alternatives incorporate the excavation and processing of the soils through mechanical mixing and separation equipment rather than in-situ treatment. Acidic solutions

(sulfuric, hydrochloric, nitric, phosphoric, and carbonic acid) have been used in industrial processes to extract metals ions, i.e., the type of contamination found at the NWS Concord site. Complexing and chelating agents could also be potentially used. Surfactants have been used for the extraction of organic contaminants. Soil washing is considered to be a developing technology and has not been field demonstrated on a large scale. However, since soil washing provides for removal of contaminants, this process will be evaluated in the alternative screening process.

4.1.14 Contaminant Immobilization. Immobilization methods are designed to render the contaminants insoluble and prevent leaching of the contaminants from the soil matrix. Waste materials are excavated, treated, and deposited in an environmentally secure disposal area. Immobilization methods generally rely on one or more of the following principles: precipitation, chelation, and polymerization. The most commonly proposed method of contaminant immobilization is chemical stabilization/solidification. This technique employs the use of binder materials usually consisting of Portland cement or pozzolanic materials to solidify the matrix containing the contaminants and to stabilize (immobilize) the contaminants. This technology has been found to be effective in treating liquids and sludges contaminated with metals; however, it has not been demonstrated sufficiently for application to materials containing organic contaminants. There is some concern that such techniques may not be appropriate to stabilize materials containing a variety of metals or contaminants because of the possibility that raising the pH of some materials may actually increase contaminant mobility. This is particularly true where arsenic is mixed with other heavy metals. In such cases, raising the pH to increase the mobility of the other metals may increase the mobility of the arsenic.

Immobilization methods are designed to render contaminants insoluble and prevent leaching of the contaminants from the soil matrix, as well as to limit their movement from the area of contamination (USEPA 1985). The immobilization agents may be applied in situ or following excavation. Immobilization is usually considered to be effective for treating metal contamination only. Stabilization/solidification techniques have been used as a treatment process prior to delisting of hazardous wastes. This is particularly important since a delisted waste could, potentially, be disposed of in a Class II or Class III

land disposal facility rather than a Class I (RCRA) facility. Therefore, immobilization technologies will be retained for further evaluation and used in conjunction with excavation technologies in the development of possible remedial action alternatives.

4.1.15 In Situ Contaminant Immobilization. An alternative to hazardous substance removal is to treat the hazardous substances in-place. A number of conceptual techniques have been proposed as "in situ" treatment methods. These techniques may be feasible for sites where hazardous substances are well defined, shallow, and the extent of contamination is small. In situ treatment has been demonstrated for application to liquids and light sludges. In situ treatment would solidify or fix contaminants in a matrix that would resist subsequent leaching or movement. Both chemical and physical methods of in situ stabilization have been attempted. There are five major categories of in situ treatment: extraction, immobilization, degradation, attenuation, and reduction of volatilization (USEPA 1984c). Most methods involve application of absorbents or chemical reagents and thorough mixing with the contaminated soil. Liming for pH control and adjustment of soil moisture content to optimize treatment conditions is also practiced. Physical stabilization using in situ vitrification (accomplished by applying high voltage via soil electrodes) has also been attempted. Most in situ treatment methods have not been demonstrated in field scale projects. Some successes have been reported in heavy metal immobilization by liming or addition of organic agricultural by-products. Such methods are usually considered to be temporary and must be repeated periodically.

There is some concern that such techniques may not be appropriate for sites where numerous metals may be present. This is particularly true for sites where arsenic is mixed with other heavy metals. In such cases, raising the pH to decrease the mobility of the other metals may increase the mobility of arsenic. In addition, chemical treatment would have to be repeated on a periodic basis.

Some immobilization agents (such as sulfides, phosphates, and hydroxides) potentially are pollutants themselves or yield toxic byproducts. The contaminants are not removed from the soils, and some of the chemical reactions may

be reversed in the presence of other reagents; this would result in the potential for renewed migration of the contamination. Organic and other non-metal contaminants are not affected by these methods.

In situ immobilization may offer a cost effective technology for application to contaminated surface soils. However, since this technology may require periodic reapplication of immobilizing reagents, it will only be considered for application in RASS 4 which has been deemed to be less environmentally sensitive than other contaminated areas.

4.1.16 Bottom Sealing. Bottom sealing is a concept for the installation of a horizontal barrier underneath the hazardous substances without disturbing the wastes. The concept is analogous to the construction of a horizontal slurry trench. The most common method proposed for bottom sealing is grout injection. Conceptually, this element would prevent or minimize groundwater from rising and falling through the hazardous substances. The concept of bottom sealing has not been demonstrated at the project level. The process is expected to be very costly because of the requirement to drill grout injection wells through the waste at close intervals. Furthermore, the effectiveness of bottom sealing cannot be assured, i.e., the quality of sealing cannot be predicted or assessed with any degree of accuracy. Since ground-water contamination is not considered to be a major concern, bottom sealing is not retained for detailed evaluation.

4.1.17 Ground Water and Leachate Treatment. Alternatives incorporating collection of leachate and/or contaminated ground water require treatment of the recovered liquids to acceptable levels of water quality. Since leachate production and groundwater contamination do not appear to be a problem at NWS Concord, this technology is not evaluated in detail. However, since soil washing and soil flushing are retained, processes similar to groundwater and leachate treatment processes will be considered.

4.1.18 Incineration. Alternatives incorporating excavation could consider the use of incineration as a hazardous substances destruction method. Incineration technologies are used primarily for the destruction of organic wastes with some heat value. Incineration is not appropriate for heavy metal

contaminated wastes. Since the problems at the NWS Concord are related to heavy metal contamination, incineration cannot be considered an applicable technology. Therefore, incineration will not be evaluated in detail.

4.1.19 Withdrawal Well Networks. A system of wells with interconnecting cones of depression can be constructed such that ground water flow is diverted or captured. Water withdrawn from the aquifer is routed to a treatment facility for discharge to surface waters or injection into the ground water aquifer. Withdrawal wells are directed to containment of contaminated ground water plumes. Since ground water contamination is not a major concern at NWS Concord, withdrawal well networks will not be evaluated in detail.

4.1.20 Flood Proofing. Portions of NWS Concord are located in tidal marshes or wetlands. Other areas are in upland areas that may be subject to periodic inundation. Inundation expected at NWS Concord is expected to be less catastrophic than traditional flood events associated with inland streams and rivers. Tidal inundation will be of more significance than stream flood events. Flood proofing is not a major concern at NWS Concord; however, flood proofing may be used in conjunction with surface water diversion to prevent severe erosion. Therefore, a detailed evaluation of flood proofing measures will be considered in proposed remedial action alternatives if appropriate.

4.1.21 Permeable Treatment Beds. Permeable treatment beds are constructed in the path of contaminated groundwater plumes as in situ treatment units. Contaminated ground water flows through the bed and the contaminant is removed or neutralized depending on the medium employed. The active medium may be an absorbent, an ion exchanger, or a reactant capable of converting the contaminant to a less hazardous or insoluble form. For heavy metals, ion exchange is the only viable medium. The advantage of permeable treatment beds is their avoidance of requirements for pumping and construction of a containment vessel. The disadvantage is the inability to regenerate the medium without physically removing it. Hence, permeable beds are best utilized in cases where contamination is at low levels so that media will not have to be regenerated during the life of the project. Ground water contamination is not a major concern at NWS Concord. Therefore, permeable treatment bed technology will not be evaluated in detail.

4.1.22 Subsurface Collection Drains. Another commonly employed ground-water recovery technique is the subsurface collection drain. Such drains consist of gravel-filled trenches usually lined with tile or perforated pipe which intercept the water table. The leachate and contaminated ground water infiltrate into the drain where the water is recovered by pumping and then treated and discharged. Subsurface collection drains can be employed to draw off leachate or infiltrate to prevent it from reaching groundwater and creating a plume. Collection drains can also be employed to lower the water table or draw plumes away from containment barriers. Ground water contamination is not a major concern at NWS Concord. Therefore, subsurface collection drains will not be evaluated in detail.

4.1.23 In Situ Heating. In situ heating is used to decontaminate soils containing hazardous organics, particularly chlorinated hydrocarbons (USEPA 1985, Dev 1986). A heat source (steam or radio frequency radiation) is applied to the soil to destroy or remove organic contaminants through thermal decomposition, vaporization, and distillation. Large amounts of energy are consumed in heating the soil, particularly if the soil is wet. Vaporized organics must be collected in a gas hood and treated prior to release. Since heavy metals are not amenable to heat treatment, and this is the major forms of contamination at NWS Concord, this method has limited application and is discarded as an appropriate technology.

4.1.24 In Situ Freezing. Artificial freezing of contaminated soils may be used to decrease the transport of volatile organics (such as benzene, chloroform, toluene, and tetrachloroelthylene) to ground water and to enhance their loss by volatilization (Iskander et al. 1986). The mobility of heavy metals may also be affected by this treatment process. This method has only been investigated at the laboratory scale. Since this technology does not have a major affect on the contaminants at the NWS Concord site, it has limited applicability and is discarded from further consideration.

4.2 Summary of Applicable Technologies

The applicability of the candidate remedial technologies evaluated in section 4.1 is summarized in Table 4.2. The technologies found to be applicable to

Table 4.2

Applicability of Remedial Technologies at NWS Concord

Available Technology	Applicable Yes	Applicable No
Recycle/Reuse		x
Waste Minimization		x
Surface Sealing and Capping	x	
Grading and Revegetation	x	
Surface Water Diversion and/or Collection	x	
Containment Barriers		x
Hydraulic Barriers		x
Excavation and Disposal	x	
Waste Biodegradation/Bioreclamation		x
Detoxification		x
Vitrification		x
Soil Flushing	x	
Soil Washing	x	
Contaminant Immobilization	x	
In Situ Contaminant Immobilization	x	
Bottom Sealing		x
Groundwater and Leachate Treatment		x
Waste Destruction		x
Withdrawal Well Networks		x
Flood Proofing	x	
Permeable Treatment Beds		x
Subsurface Collection Drains		x
In Situ Heating		x
In Situ Freezing		x

NWS Concord will be used to formulate appropriate remedial action alternatives. These alternatives are formulated and evaluated in Sections 5, 6, 7, and 8 of this FS.

5.0 REMEDIAL ACTION ALTERNATIVE DEVELOPMENT AND INITIAL SCREENING

5.1 Background

Once the preliminary screening of technologies has been accomplished (Section 4), those technologies surviving the screening process can be combined into alternative remedial actions that address site specific problems. These alternatives are, in turn, subjected to an initial screening process to narrow the list of potential remedial actions requiring detailed analysis. Section 300.68(f) of the NCP requires, to the extent that it is both possible and appropriate, that at least one alternative in each of the following categories be included in the analysis.

a. Alternatives for treatment or disposal at an off site facility.

b. Alternatives that attain applicable or relevant and appropriate Federal public health and environmental requirements.

c. Alternatives that exceed applicable or relevant and appropriate Federal public health and environmental requirements.

d. Alternatives that do not attain applicable or relevant and appropriate Federal public health and environmental requirements but will reduce the likelihood of present or future threat from the hazardous substances and that provide significant protection to public health and welfare and the environment, including an alternative that closely approaches the level of protection provided by the applicable or relevant and appropriate requirements.

e. A no action alternative.

In this section, the technically feasible remedial technologies identified in Section 4 are grouped into potential remedial action alternatives. These alternatives are screened based on environmental and public health considerations, engineering feasibility, and cost. Cost screening is based on cost data presented in Cullinane et al. (1986). Cost screening is based on a comparative cost evaluation. Cost estimates for screening purposes are assumed

to be ±25 percent. The purpose of the screening step is to identify those alternatives of sufficient merit to undergo detailed evaluation. As a result of the initial screening process the detailed evaluation process can be directed toward clearly superior alternatives.

In view of different amounts and types of contamination, leading to different degrees of public health and environmental risks, and the differing physical conditions on the seven contaminated areas evaluated in this FS, the areas were consolidated into four subsites for development of remedial alternatives. The consolidation process is described in Section 2.2. The purposes of this consolidation are 1) to allow consideration of different remedial technologies/alternatives for each area, 2) to provide the flexibility in decision making to select the most cost effective remedial alternative for each area, and 3) to minimize the number of alternatives that must be evaluated. The consolidation of the areas into subsites also streamlines alternative screening and evaluation without reducing the accuracy of the overall process. Consolidation also responds to numerous comments received on the draft FS (Cullinane et al. 1986).

There is only one basic alternative involving source removal, i.e. excavation. However, there are several alternatives for treatment, transport, and final disposal of the materials that are removed from the remediation site.

5.1.1 Treatment

Two treatment options were identified as potentially applicable to contaminated materials that would be removed from the remediation sites: solidification/stabilization and soil washing. Solidification/stabilization uses the addition of various chemical reagents to immobilize the contaminants in the soil. Soil washing uses various solvents to remove the contaminants from the soil and concentrate them into residual sludges and spent process liquors.

5.1.2 Transportation

Several alternative transportation methods are available for transport of materials to final disposal facilities: truck, rail, and intermodal using a combination of truck and rail.

5.1.2.1 Truck. Truck transport is the preferred option for short haul transport of materials to landfills. Transport is usually in lined and covered end-dump trucks. California has a gross weight limit for highway transportation of 80,000 pounds. For planning purposes, this allows a live load ranging from 40,000 to 46,000 pounds. Assuming a soil weight of 2500 lbs/cubic yard, a standard load would range between 16 and 18 cubic yards. The cost of truck transport is generally a function of the distance from the remediation site to the disposal facility. However, because of competition, distance alone may not be an absolute indicator of transportation costs.

5.1.2.2 Rail. Since the remedial action site is transected by several railroads, direct rail transport may be an attractive option for long hauls such as transport of materials to distant Class I disposal facilities. Direct rail transport could be accomplished using 200,000 pound gross load (160,000 pound live load) gondola cars. Assuming a soil weight of 2500 lbs/cubic yard, a standard load would be approximately 64 cubic yards. Rail cars would be covered to prevent loss of materials. Since none of the California Class I disposal sites have direct rail facilities, transfer facilities would have to be constructed if disposal were in a California facility. Materials would be off-loaded from the rail cars, loaded onto trucks, and transported the final short distance to the disposal facility. Double handling of materials in this fashion will result in higher costs and increased public concerns. For these reasons, truck transport is assumed for all transport involving California disposal facilities. The Utah Class I disposal facility has direct rail transport facilities. Therefore, rail transport will be considered as the primary means of transportation from the remedial action site to the Utah disposal facility.

5.1.2.3 Intermodal. Intermodal transportation includes a combination of truck and rail transport services. Since the remedial action site is

transected by several railroads, it is conceivable that materials could be loaded on trucks which in turn are loaded on rail cars for shipment to a location near the disposal facilities. At this point, the trucks are off-loaded and driven to the disposal facility. Intermodal transportation was not evaluated in detail; however, if a California disposal facility is selected, intermodal transport should be evaluated as a cost saving measure.

5.1.3 Disposal

Analysis of existing data indicates that soils to be excavated may include Class I, Class II, and Class III materials. There are two primary options for handling and disposal of the materials after excavation: disposal in an existing licensed disposal facility and disposal in a monofill constructed on NWS Concord. This latter option has two suboptions: construction of the monofill on-site (within the boundaries of the remedial action site) or construction of the monofill off-site (outside the boundaries of the remedial action site but still on NWS Concord).

5.1.3.1 Disposal in an Existing Facility. Off-site disposal of excavated materials in an existing licensed landfill is considered as a primary materials disposal alternative. Several existing disposal facilities have been identified and are presented in Table 5.1. The general locations of available Class I facilities are shown on Plate 5.1.

5.1.3.2 Disposal on NWS Concord. Construction of a monofill on NWS Concord was evaluated as a secondary disposal alternative. Disposal on NWS Concord is an attractive disposal alternative because of savings in transportation cost, a reduction of public concern related to the transport of contaminated materials over public rights of way, a reduction in disposal costs, and reduction in the loss of capacity in existing landfills. These apparent advantages are offset by the long term operation and maintenance requirements associated with the landfill, loss of land use on NWS Concord, and extensive investigations required for facility siting.

On-site disposal was considered, however, the size of the remedial action site considered in this FS limits the available area for on-site disposal.

Table 5.1

Licensed Off-Site Disposal Facilities

	Facility 1	**Facility 2**
Class I:	Chemical Waste Management Kettleman Hills, California 39899 Balentine Suite 320 Newark, CA 94560 (415) 651-2964	U.S. Pollution Control, Inc. Grassy Mountain Facility 5662 South 300 West Murray, Utah (801) 534-0054
	Facility 3	
Class II:	ACME Fill Corporation Martinez, California 94553 (415) 228-7099	
	Facility 4	**Facility 5**
Class III:	Altamont Sanitary Landfill 10840 Altamont Pass Road Livermore, California 94550 (415) 449-6349	Richmond Sanitary Service West Contra Costa Landfill Richmond, California (415) 236-8000
	Facility 6	
	Acme Fill Corporation Martinez, California 94553 (415) 228-7099	

[1] Presently closing.

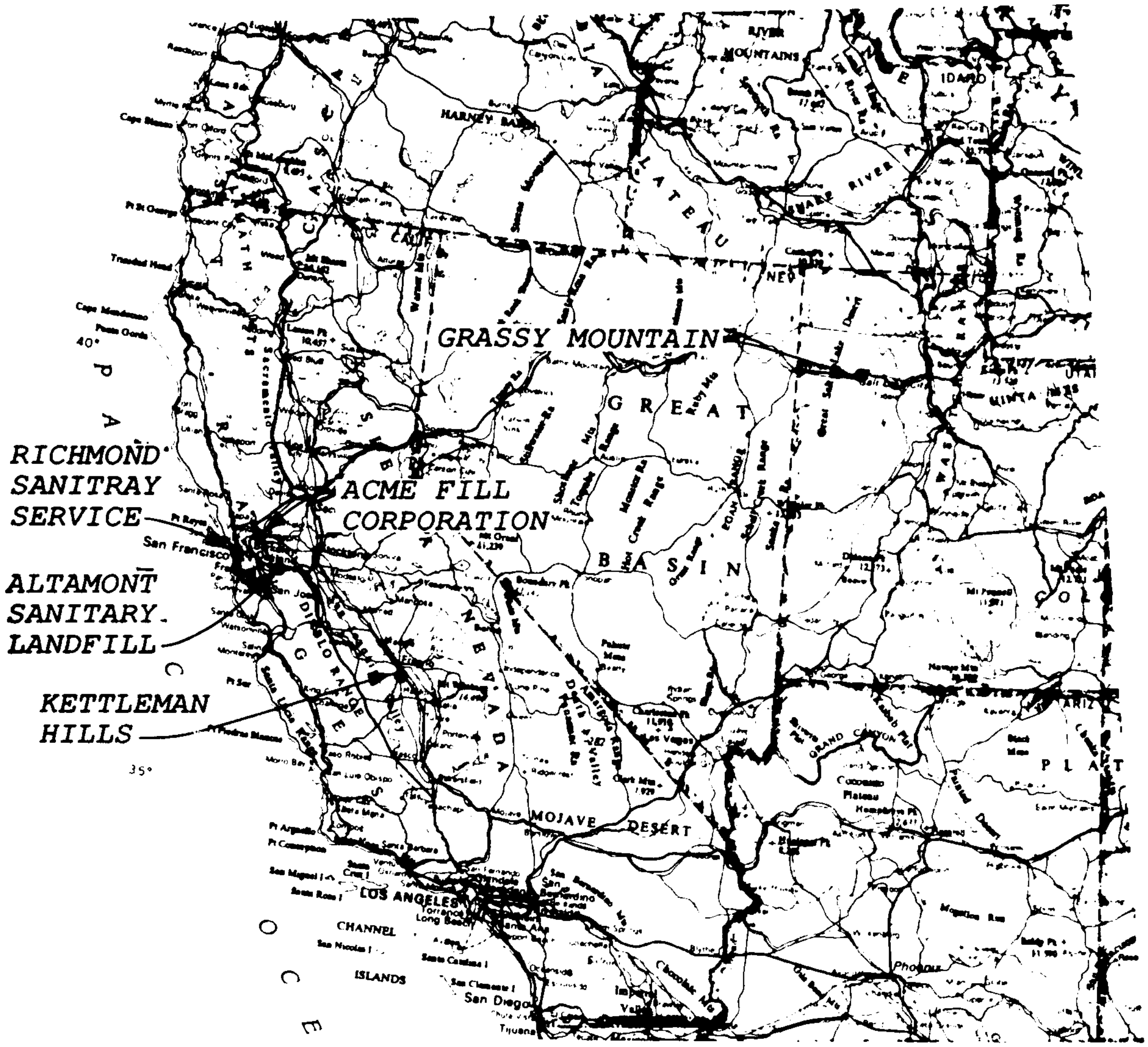


Plate 5.1. Locations of existing licensed landfills

Available area for waste disposal is further limited by the topographic, hydrologic, and geologic conditions found on the site. One candidate location for construction of an on-site disposal facility was identified on RASS 3, immediately north of Port Chicago Highway (Site 10 on Plate 5.2). Lutton et al. (1987) investigated this site and found that it did not meet the State criterion requiring permeability $<10^{-7}$ for sufficient thickness to preclude migration of contaminants to the underlying ground water. Thus, disposal of Class I wastes would not be allowed. Site 10 is marginally suited as a location for a Class III facility. Treatment of the excavated soils and redesignation as a Class III material or a "designated" waste would be feasible; however, because of geologic uncertainties, any landfill located on NWS Concord should be engineered to Class I standards, unless the contaminants have been removed from the soil.

Construction of an off-site (remote from the remedial action site) monofill disposal facility on lands controlled by NWS Concord was also considered as an alternative to transporting excavated materials to existing licensed landfill facilities. Lutton et al. (1987) investigated eleven potential disposal sites on the NWS Concord, including the previously mentioned Site 10 on RASS 3. The primary emphasis of this study was location of a site for disposal of Class I materials. Six of the eleven candidate sites passed an initial screening based on surficial requirements found in State criteria. Five of the six sites surviving the initial screening process were investigated by drilling, sampling, and testing of the geological conditions underlying each site. The sixth site was deemed to be geologically similar to one of the five sites investigated in detail. None of the sites was found to meet the State criterion requiring permeability $<10^{-7}$ for sufficient thickness to preclude migration of contaminants to the underlying ground water. Accordingly, construction of a Class I disposal facility on NWS Concord is deemed to be infeasible because of regulatory requirements related to the underlying geological conditions. Several sites are suitable for construction of Class III disposal sites. Treatment of the excavated soils and reclassification as a Class III material would be feasible; however, because of geologic uncertainties, any landfill should be engineered to Class I standards.

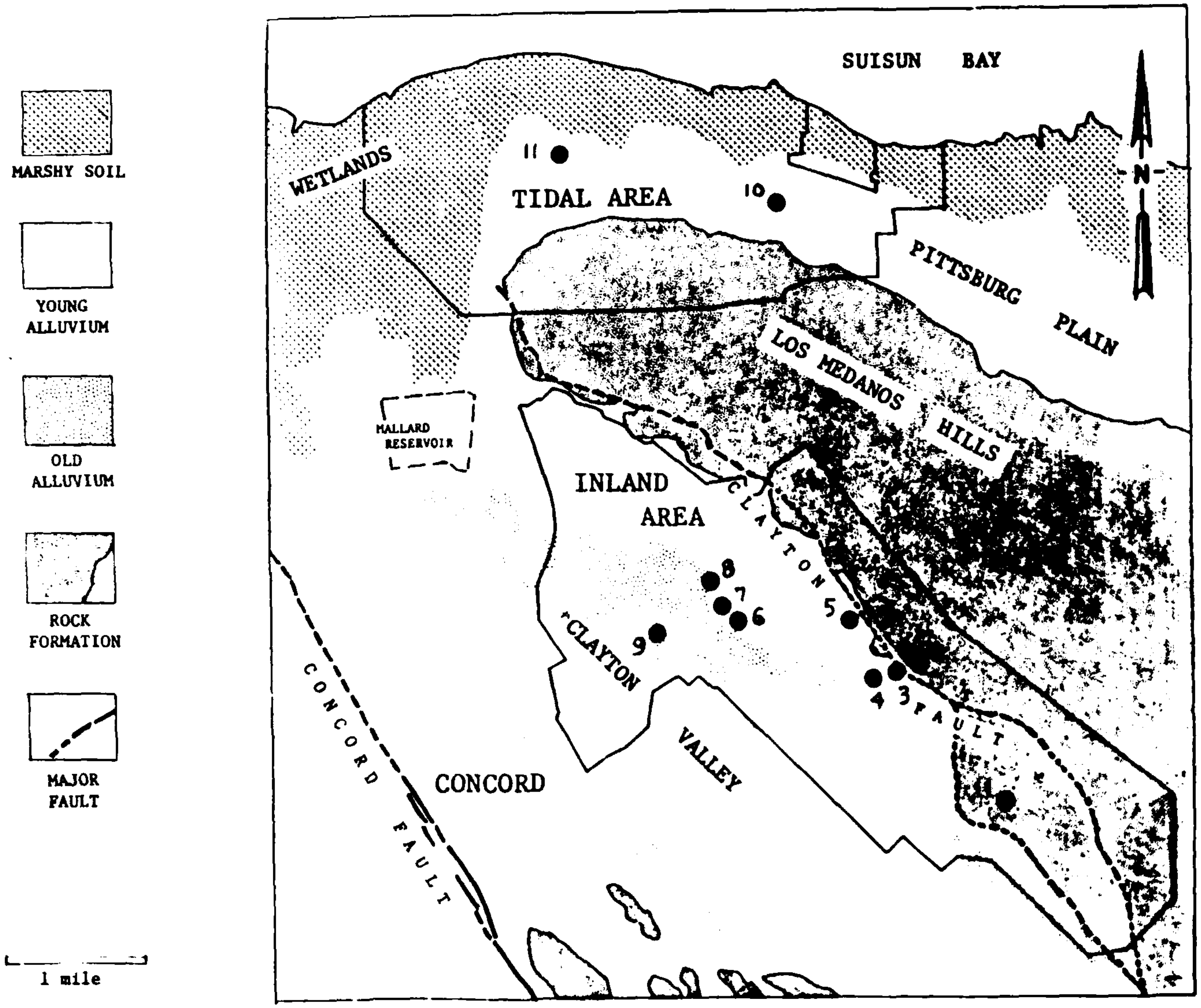


Plate 5.2. Potential locations for a monofill on NWS Concord (Lutton et al. 1987).

Alternatives using combinations of the treatment, transport, and disposal options were developed for each of the RASS's included in this FS.

5.2 Combination of Potentially Applicable Technologies into Feasible Remedial Alternatives

An overview of the technology screening presented in Section 4 indicates that seven basic remedial alternatives are available for the remediation of contaminated surface soils.

a. No Action;
b. Environmental Monitoring;
c. Removal and Disposal;
d. Removal, Treatment, and Disposal;
e. Source Isolation (containment with capping);
f. Site Restoration, and
g. In Situ Treatment.

Various combinations of technology are available within each of these categories. Alternatives in each of these seven categories are discussed below.

5.2.1 Alternatives for Remedial Action Subsite 1. Fourteen potential remedial action alternatives were initially developed for RASS 1. These included:

a. Alternative 1-1: No Action
b. Alternative 1-2: Environmental Monitoring
c. Alternative 1-3A: Excavation/Disposal at Existing Landfills
d. Alternative 1-3B: Excavation/Disposal at Monofill on NWS Concord
e. Alternative 1-3C: Excavation/Immobilization/Disposal at Existing Landfills
f. Alternative 1-3D: Excavation/Immobilization/Disposal at Monofill on NWS Concord
g. Alternative 1-3E: Excavation/Soil Washing/Disposal at Existing Landfills
h. Alternative 1-3F: Excavation/Soil Washing/Disposal at Monofill on NWS Concord
i. Alternative 1-4A: Source Isolation/Soil Cap
j. Alternative 1-4B: Source Isolation/RCRA Cap
k. Alternative 1-5A: On Site Restoration

l. Alternative 1-5B: Off Site Restoration

m. Alternative 1-6A: In Situ Stabilization

n. Alternative 1-6B: Soil Flushing

5.2.1.1 Alternative 1-1: No Action

Description. The no action alternative involves no additional positive remedial action activities. Soils containing high levels of arsenic and heavy metals in RASS 1 would be left in place. No additional monitoring would be implemented. Warning signs and public education programs would be used to inform the public about potential hazards. Property records would be annotated to document the location of known and suspected contamination.

Environmental and Public Health Screening. The no action alternative would not measurably change the current likelihood of exposure of aquatic and wetland biota to very high concentrations of arsenic and heavy metals in the wetland sediments. The possibility of direct human contact with the contaminated sediments would be only minimally reduced with signs and an education program.

Under the no action alternative, contaminants would continue to migrate from the contaminated area through the pathways described in Section 3.1. The areal extent of contamination would increase and spread from RASS 1 into the surrounding wetlands and eventually into Suisun Bay. While the concentrations of contaminants might be attenuated by natural dilution effects, a wider range of aquatic and wetland biota would be exposed to the contaminants. In addition, the potential for large discharges of sediment sorbed contaminants would continue to exist whenever a storm and/or abnormal high tide occurs at NWS Concord. Such events would inevitably expose aquatic and wetland biota to higher concentrations of contamination.

On site sampling and subsequent analysis have confirmed that significant quantities of hazardous substances exist in the surface soils (upper 12 in.) of RASS 1. These substances are subjected to environmental stresses from the horizontal flow of surface water over and through the hazardous substances and, to a lesser extent, vertical infiltration of water through the waste and

into the ground water and wind generated fugitive dust. It is anticipated that migration of contaminants from the site through the surface water media will continue in both the near and long term.

The potential environmental effects of the no action alternative are described in detail by Lee et al. (1985, 1986, 1988) and O'Neil (1988). The no action alternative does not provide the necessary reduction in endangerment or continued environmental impacts required by the environmental protection goal.

Engineering Feasibility. The technologies proposed for implementation under the No Action alternative are standard engineering practices that could be executed without undue delay.

Costs. The costs associated with implementation of the No Action alternative are expected to be minimal. Based on the data developed by Cullinane et al. (1986), the present worth cost of the no action alternative is estimated to be approximately $83,000.

5.2.1.2 Alternative 1-2: Environmental Monitoring

Description. The environmental monitoring alternative features the no action alternative, i.e., no additional active remediation, augmented by implementation of continued environmental monitoring. Contaminated materials would be left in-place. A two part environmental monitoring program would be implemented to periodically evaluate the environmental status of RASS 1 and those adjacent areas onto which contaminants are likely to migrate. At a minimum, the increased monitoring program would include surface and ground water sampling, soil and sediment sampling, bioassays, and wildlife and habitat evaluations.

Phase 1 monitoring includes the collection and analysis of soil, surface water, and ground water samples. In addition, wildlife and vegetation would be observed and evaluated. Phase 1 monitoring would be conducted annually for the first five years and every five years thereafter.

Phase 2 monitoring is oriented towards the evaluation of contaminant impacts on the biota of RASS 1 and adjacent areas. Phase 2 monitoring would be conducted every two years for the first five years and every five years thereafter. Phase 2 monitoring includes: clam and vegetation bioassays, macroinvertebrate studies, and animal bioaccumulation studies.

Monitoring studies would be summarized in an annual report describing the results of the various sampling programs. The report would also contain an assessment of any physical changes in RASS 1 or adjacent areas, i.e., natural improvement or degradation of habitats, man-made alterations, etc. The report would also make recommendations for implementation of any required active remedial actions.

Environmental and Public Health Screening. The monitoring alternative would not measurably change the current likelihood of exposure of aquatic and wetland biota to very high concentrations of arsenic and heavy metals in the wetland sediment. The possibility of direct human contact with the contaminated soils would be minimally reduced by posting of contaminated areas and a public education program.

The monitoring program would allow continued migration of arsenic and other heavy metals from the areas of high contaminant concentrations and the areal extent of the contamination would continue to increase. There would be some attenuation of the high levels of contamination because of dilution effects. The potential environmental effects are essentially the same as the no action alternative and are described in Lee et al. (1985, 1986, 1988) and O'Neil (1988). The threat of contamination of plants and wildlife, including endangered species, would continue and the potential for exposure would increase as the areal extent of contamination increased.

The environmental monitoring alternative would provide only limited positive environmental protection benefits above those provided by the no action alternative. Although this alternative would not eliminate or reduce contamination of soils, surface waters, or sediments by continued migration of contaminants from current high level areas, monitoring would provide documentation of contaminant migration and its longer term environmental impact. Wildlife studies

would document species use of RASS 1, the contamination levels of collected species, and problems caused by continuous exposure to the hazardous substances. The environmental monitoring program would also provide an early warning of changes in conditions that may increase the potential for substantial environmental damage by continued contaminant release or an unexpected increase in the rate of release.

Engineering Feasibility. The technologies proposed for implementation under this alternative are standard engineering and scientific practices that can be executed without project delay. Care must be taken to ensure that the sample size for biological monitoring is sufficient and organized in such a way as to allow for the evaluation of statistical significance. Difficulties may be encountered in the development of proposed action levels; however, these difficulties are not expected to present a major obstacle to execution of this alternative.

Costs. The present worth cost of Alternative 1-2 is anticipated to be approximately $3,464,000. These costs are substantially greater than the no action alternative; but significantly less than implementation of more active remedial action alternatives.

5.2.1.3 Alternative 1-3A: Excavation/Disposal at Existing Landfills

Description. The excavation and disposal at existing landfill alternative consists of excavating contaminated materials followed by land disposal at a licensed off-site land disposal facility. If found to be feasible during concept design, excavated materials would be classified into appropriate categories (Class I, Class II, and Class III) for disposal in the appropriate level landfill. The major components of this alternative include: excavation of contaminated materials, classification of the contaminated materials, transport of the contaminated materials to the appropriate existing disposal facility, disposal, and monitoring of the remediation area. The primary means of transportation assumed for planning purposes is either lined and covered dump trucks with a capacity of approximately 16-18 cubic yards or covered rail cars with a capacity of 64 cubic yards. A survey of disposal facilities is presented in Table 5.1. These facilities have indicated that they are

licensed to dispose of the types of waste materials that will be generated by the remediation activities anticipated in RASS 1.

Environmental and Public Health Screening. This alternative provides for substantial remediation of ecological and health hazards associated with contaminated soils in RASS 1, including possible migration of contaminated materials to other important ecosystems such as Suisun Bay.

Excavation of contaminated soils presents the potential for adverse effects caused by exposure of construction personnel and persons located off site to the excavated materials during transport of the materials to existing disposal facilities. The excavation of contaminated materials would impact the important wetland habitat found in RASS 1 and would impact resident wildlife populations by death or displacement. Over time, the area of excavation will tend to silt in and the vegetation would recover. Uncertainty exists in the time required for silting and vegetation to recover. The probability that a pickleweed wetland will eventually establish naturally is low and the uncertainty is high. Consequently, natural recovery of suitable habitat for the protected species will more than likely have a low probability of success. Before recovery, the habitat would be either a mudflat or standing water, depending on the final elevation and drainage patterns. Neither of these types of habitat would be suitable for the protected species currently on site (Lee et al. 1986). These temporary impacts would be offset by the potential for long term recovery of the area once the contaminated materials have been removed.

Anticipated short term impacts can be minimized by proper planning of construction activities. For example, major construction activities can be timed to avoid the months when the highest level of wildlife reproductive activity occurs.

Trucks or rail cars would be used for transporting contaminated soils to land disposal facilities. Therefore, the off site disposal of contaminated materials has the additional risk of exposure of the public to contaminated materials during transport of these materials to the disposal facilities. Trucks and rail cars would be lined and covered; however, passage through towns and

communities would raise community concerns. Increased traffic would cause increased noise levels; a possible increase in accidents, which could cause loss of life; air pollution; and increased exposure to spilled contaminated materials.

Alternative 1-3A provides long term environmental protection at the expense of major short term environmental impacts. In the long term, a contaminant free area, natural regrowth of vegetation, and return of wildlife may off set short term impacts. However, there is a low probability that the habitat would be suitable for the protected species currently inhabiting RASS 1.

Engineering Feasibility. The technologies proposed for implementation under Alternative 1-3A are standard engineering and scientific practices that can be executed without project delay. Excavation of contaminated materials from wetlands may present minor problems in execution of this alternative. Primary technical concerns include the ability to excavate in wetlands, the moisture content of the excavated materials, the load bearing strength of the soils being excavated (will they support construction equipment), sedimentation and compaction effects on areas not selected for active remediation, and transportation and disposal of Class I materials. Difficulties may also be encountered in the development of proposed action levels for the monitoring plan.

Several excavation techniques are available for use in wetlands. A combination of bulldozers, clamshells, frontend loaders, and dump trucks can be used for excavation. In order to minimize technical problems associated with excavation, these activities should be scheduled for the dry season. This may increase the fugitive dust problem; however, this can be controlled by sprinkling or other dust control measures. Excavation during the dry season will also minimize the potential problem of free liquids in the contaminated soils. Sedimentation effects on adjacent areas could be controlled by existing technology such as silt barriers and silt screens.

Transportation of contaminated materials to existing landfills would be by truck or rail. Both truck and rail transportation of contaminated soils are proven technologies. The loss of contaminated materials will be minimized through the use of liners and covers.

Disposal of contaminated soils in a Class I landfill is a proven technology. Although there are usually technical concerns over the possibility that the landfill will leak, these concerns are usually addressed through the implementation of siting controls and engineered features such as liners and leak detection systems. There are several Class I landfills in operation that can accept the types of materials that will be excavated from RASS 1.

The environmental monitoring techniques are standard engineering and scientific practices that can be executed without project delay. Care must be taken to ensure that the sample size for the biological monitoring is sufficient and organized in such a way as to allow for evaluation of statistical significance. Difficulties may be encountered in the development of proposed action levels; however, these difficulties are not expected to present a major obstacle to execution of this alternative.

Costs. The present worth cost of Alternative 1-3A is anticipated to be approximately $4,722,000 based on Cullinane et al. (1986). These costs are substantially greater than the no action or monitoring alternatives. However, Alternative 1-3A provides positive remediation of the heavy metal and arsenic contamination.

5.2.1.4 Alternative 1-3B: Excavation/Disposal at Monofill on NWS Concord

Description. The excavation and disposal at a monofill on NWS Concord alternative consists of excavating contaminated materials followed by disposal in a monofill located on NWS Concord. Only materials excavated from the remedial action site would be placed in the monofill. The monofill would be constructed to Class I standards. The major components of this alternative include: excavation of contaminated materials, transportation of the contaminated materials to the disposal area, disposal, long term monitoring of the remediation area, and long term monitoring of the disposal area. The primary means of transportation assumed for planning purposes is in lined and covered dump trucks with a capacity of approximately 16-18 cubic yards. A survey of suitable sites for construction of a disposal facility on the NWS Concord was conducted (Lutton et al. 1987). Potential sites are shown on Plate 5.2. None

of these sites meet State of California siting requirements for a Class I landfill.

Environmental and Public Health Screening. This alternative provides for substantial remediation of ecological and health hazards associated with contaminated soils in RASS 1, including possible migration of contaminated materials to other important ecosystems such as Suisun Bay.

Alternative 1-3B presents the potential for adverse effects caused by exposure of construction personnel and persons located between the area of excavation and disposal to the excavated materials during transport of the materials to the disposal facilities. The excavation of contaminated materials will also impact the important wetland habitat found in RASS 1 and would impact resident wildlife populations by death or displacement. Over time, however, the area of excavation will tend to silt in and the vegetation would recover. Uncertainty exists in the time required for silting and vegetation to recover. The probability that a pickleweed wetland will eventually establish naturally is low and the uncertainty is high. Consequently, natural recovery of suitable habitat for the protected species will more than likely have a low probability of success. Before recovery the habitat will be either a mudflat or standing water, depending on the final elevation and drainage patterns. Neither of these types of habitat would provide habitat for the protected species currently on site (Lee et al. 1986). These temporary impacts would be offset by the potential for long term recovery of the remediation area once the contaminated materials have been removed.

Anticipated short term impacts can be minimized by proper planning of construction activities. For example, major construction activities can be timed to avoid the months when the highest level of reproductive activity occurs.

Trucks would be used for transporting contaminated soils to land disposal facilities. The disposal of contaminated materials on NWS Concord minimizes the risk of exposing the general public to contaminated materials during transport of these materials to the disposal facilities. The increase in truck traffic would cause noise pollution and a possible increase in

accidents, which could cause loss of life, air pollution, and increased exposure to spilled contaminated materials for personnel working on NWS Concord.

Alternative 1-3B provides long term environmental protection at the expense of major short term impacts. In the long term, natural regrowth of vegetation may offset any short term impacts. However, there is a low probability that the habitats would be suitable for the protected species currently inhabiting RASS 1.

Engineering Feasibility. The technologies proposed for implementation under Alternative 1-3B are standard engineering and scientific practices. Primary technical concerns include the ability to excavate in wetlands, the moisture content of the excavated materials, the load bearing strength of the soils being excavated (will they support construction equipment), sedimentation effects on areas not selected for active remediation, transportation and disposal of Class I materials, construction of a Class I monofill on NWS Concord, and development of proposed action levels.

Excavation of contaminated materials from wetlands may present problems in execution of this alternative. Several excavation techniques are available that can be used to excavate contaminated wetland materials. A combination of bulldozers, clamshells, frontend loaders, and dump trucks can be used for excavation. In order to minimize technical problems associated with excavation, excavation activities should be scheduled for the dry season. This may increase the fugitive dust problem; however, this can be controlled by sprinkling or other dust control measures. Excavation during the dry season will also minimize the potential problem of free liquids in the contaminated soils. Sedimentation effects on adjacent areas can be controlled by existing technology such as silt barriers and silt screens.

Transportation of contaminated materials to the monofill would be by truck, which is a proven technology. The loss of contaminated materials will be minimized through the use of liners and covers.

Disposal of soils containing high levels of heavy metals and arsenic in a Class I landfill is a proven technology. Although there are usually technical

concerns over the possibility that the landfill will leak, these concerns are usually addressed through the implementation of siting controls and engineered features such as liners and leak detection systems. An investigation of potential Class I disposal sites on NWS Concord revealed that none of the available sites meet State of California siting requirements for a Class I facility (Lutton et. al. 1987). Therefore, the technical feasibility of implementing Alternative 1-3B is doubtful.

The environmental monitoring techniques are standard engineering and scientific practices that can be executed without project delay. Care must be taken to ensure that the sample size for the biological monitoring is sufficient and organized in such a way as to allow evaluation of statistical significance. Difficulties may be encountered in the development of proposed action levels; however, these difficulties are not expected to present a major obstacle to execution of this alternative.

Costs. The present worth cost of Alternative 1-3B are anticipated to be approximately $4,100,000. These costs are substantially greater than the no action or environmental monitoring alternative; however, these costs are significantly less than implementation of more active remedial action alternatives.

5.2.1.5 Alternative 1-3C: Excavation/Immobilization/Disposal at Existing Landfills

Description. The excavation/immobilization/disposal at existing landfill alternative consists of excavating contaminated materials, immobilization of the contaminants by addition of chemical reagents, land disposal at an existing licensed land disposal facility, and long term monitoring of the remediation area. If feasible, excavated materials will be classified into the appropriate categories (Class I, Class II, and Class III). Class I and Class II materials would be treated with chemical reagents to immobilize the contaminants. This process is generally referred to as chemical solidification/stabilization (USEPA 1986a). Typical solidification/stabilization methods include the addition of 25-100 percent by weight of cement, pozzolanic and/or proprietary materials. It is assumed that this

process is capable of immobilizing the contaminants and the materials would be suitable for disposal in a Class III land disposal facility. The major components of this alternative include: excavation of contaminated materials, classification of the contaminated materials, immobilization of contaminants in Class I and Class II wastes, transportation of the contaminated materials to the appropriate disposal facility, disposal, and implementation of a long term monitoring program. The primary means of transportation assumed for planning purposes is in lined and covered dump trucks with a capacity of approximately 18 cubic yards. A survey of disposal facilities within reasonable distance from the NWS Concord is presented in Table 5.1.

Environmental and Public Health Screening. This alternative provides for substantial remediation of ecological and health hazards associated with contaminated soils in RASS 1, including possible transport of contaminated materials to other important ecosystems such as Suisun Bay.

Excavation of contaminated materials presents the potential for adverse effects caused by exposure of construction personnel and the general public to the excavated materials during transport of the materials to existing disposal facilities. Impacts on the general public will be minimized because the contaminants would be immobilized in the soil. Fugitive dust may be a problem; however, this can be minimized through proper planning and design. The excavation of contaminated materials will also impact the important wetland habitats found in RASS 1 and would impact resident wildlife populations by death or displacement. Over time, however, the area of excavation will tend to silt in and the vegetation would recover. Uncertainty exists in the time required for silting and vegetation to recover. The probability that a pickleweed wetland will eventually establish naturally is low and the uncertainty is high. Consequently, natural recovery of suitable habitat for the protected species will more than likely have a low probability of success. In the short term, the habitat will be either a mudflat or standing water, depending on the final elevation and drainage patterns. Neither of these types of habitat would provide habitat for the protected species currently on-site (Lee et al. 1986). These short term impacts would be offset by the potential for long term recovery of the area once the contaminated materials have been removed.

Anticipated short term impacts can be minimized by proper planning of construction activities. For example, major construction activities can be timed to avoid the months when the highest level of reproductive activity occurs.

Trucks would be used for transporting contaminated soils to land disposal facilities. Therefore, the disposal of contaminated materials in existing landfills has the additional risk of exposure of the general public to contaminated materials during transport of these materials to the disposal facilities. Although the trucks would be lined and covered and the materials would be stabilized, passage of the trucks through towns and communities would raise community concerns. Additional truck traffic would cause noise pollution and a possible increase in accidents, which could cause loss of life, air pollution, and increased exposure to spilled contaminated materials. These concerns would be reduced somewhat because contaminants would be immobilized in the soil.

Alternative 1-3C provides long term environmental protection at the expense of significant short term impacts. In the long term, natural regrowth of vegetation may offset any short term impacts. However, there is a low probability that the habitat would be suitable for the protected species currently inhabiting RASS 1.

Engineering Feasibility. The technologies proposed for implementation under Alternative 1-3C are standard engineering and scientific practices that can be executed without project delay. Primary technical concerns include the ability to excavate in wetlands, the moisture content of the excavated materials, the load bearing strength of the soils being excavated (will they support construction equipment), sedimentation effects on areas not selected for active remediation, transporation and disposal of Class III materials, development of solidification/stabilization process, and development of proposed action levels for the environmental monitoring program.

Several excavation techniques are available that can excavate the contaminated wetland materials. A combination of bulldozers, clamshells, frontend loaders, and dump trucks can be used for excavation. In order to minimize technical problems associated with excavation, these activities should be scheduled for

the dry season. This may increase the fugitive dust problem; however, this can be controlled by sprinkling or other dust control measures. Excavation during the dry seasons will also minimize the potential problem of free liquids in the contaminated soils.

Transportation of contaminated materials to existing landfills would be by truck, which is a proven technology. The loss of contaminated materials would be minimized through the use of liners and covers.

Co-disposal of solidified/stabilized soils in an existing Class III landfill may raise technical concerns over the long term durability of such materials in the Class III environment. Special placement procedures would have to be implemented. Co-disposal may be prohibited by regulatory authorities.

Solidification/stabilization of wastes containing high levels of heavy metals has been demonstrated; however, the process must be developed on a site specific basis. Implementation of a solidification/stabilization technology in California is complicated by the two phase test procedure (TTLC/STLC) and the use of a citric acid extraction that is substituted for the acetic acid extraction of the U.S. EPA's Extraction Procedure. Solidification/stabilization does not remove the metals and other than for the dilution effects caused by adding large amounts of binder, the TTLC is essentially unchanged. The citric acid extraction is generally believed to be more rigorous than the acetic acid extraction and the data base for successful solidification/stabilization when using a citric acid extraction is limited. Discussions with State of California regulatory personnel (Tornatore 1988) indicated that some success has been demonstrated in reducing the STLC and that special waivers of the TTLC requirement may be made when solidification/stabilization is implemented.

The proposed environmental monitoring techniques are standard engineering and scientific practices that can be executed without project delay. Care must be taken to ensure that the sample size for the biological monitoring is sufficient and organized in such a way as to allow evaluation of statistical significance. Difficulties may be encountered in the development of proposed

action levels; however, these difficulties are not expected to present a major obstacle to execution of this alternative.

Costs. The present worth cost of Alternative 1-3C is anticipated to be approximately $3,355,000. These costs are substantially greater than the no action or monitoring alternative. However, Alternative 1-3C provides positive remediation of the contaminated area in RASS 1. In addition, solidification/ stabilization minimizes the possibility that the metals removed from RASS 1 will be mobilized in the future.

5.2.1.6 Alternative 1-3D: Excavation/Immobilization/Disposal at Monofill on NWS Concord

Description. The excavation/immobilization/monofill disposal option consists of excavating contaminated materials, immobilization of the contaminants by addition of chemical reagents, and land disposal in monofill located on NWS Concord. The excavated materials will be classified into the appropriate categories (Class I, Class II, and Class III). Class I and Class II materials would be treated with chemical reagents to immobilize the contaminants. This process is generally referred to as chemical solidification/stabilization (USEPA 1986a). Typical solidification/stabilization methods include the addition of 25-100 percent by weight of cement, pozzolanic, and/or proprietary materials. It is assumed that this process is capable of immobilizing the contaminants and the materials would be suitable for disposal in a land disposal facility constructed to Class III standards. The major components of this alternative include: excavation of contaminated materials, classification of the contaminated materials, immobilization of contaminants in Class I and Class II wastes, transportation of the contaminated materials to the disposal site, disposal in a monofill constructed on NWS Concord, long term monitoring of the remediation site, and long term monitoring of the monofill. The primary means of transportation assumed for planning purposes is in lined and covered dump trucks with a capacity of approximately 18 cubic yards.

Environmental and Public Health Screening. This alternative provides for substantial remediation of ecological and health hazards associated with

contaminated soils in RASS 1, including possible transport of contaminated materials to other important ecosystems such as Suisun Bay.

Excavation of contaminated material presents the potential for adverse effects caused by exposure of construction personnel and persons located on NWS Concord to contaminants during transport of the materials to the monofill. Impacts on the general public would be minimized because the contaminants would be immobilized in the soil and the contaminated soils would be disposed of on NWS Concord. Fugitive dust may be a problem; however, this can be minimized through proper planning and design.

The excavation of contaminated materials would also impact the important wetland habitats found in RASS 1 and would impact resident wildlife populations by death or displacement. Over time, however, the area of excavation will tend to silt in and revegetation would recover. Uncertainty exists in the time required for silting and vegetation to recover. The probability that a pickleweed wetland will eventually establish naturally is low and the uncertainty is high. Consequently, natural recovery of suitable habitat for the protected species will more than likely have a low probability of success. In the short term, the habitat would be either a mudflat or standing water, depending on the final elevation and drainage patterns. Neither of these types of habitat would provide habitat for the protected species currently on-site (Lee et al. 1986). These short term impacts would be offset by the potential for long term recovery of the area once the contaminated materials have been removed.

Anticipated short term impacts can be minimized by proper planning of construction activities. For example, major construction activities can be timed to avoid the months when the highest level of reproductive activity occurs.

Trucks would be used for transporting solidified/stabilized soils to the monofill. Additional truck traffic would cause noise pollution and a possible increase in accidents, which could cause loss of life, air pollution, and increased exposure to spilled contaminated materials. These impacts would be limited to NWS Concord and public transportation corridors traversing NWS Concord.

Alternative 1-3D provides long term environmental protection at the expense of significant short term impacts. In the long term, natural regrowth of vegetation may offset any short term impacts. However, there is a low probability that the habitat would be suitable for the protected species currently inhabiting RASS 1.

Engineering Feasibility. The technologies proposed for implementation under Alternative 1-3D are standard engineering and scientific practices. Primary technical concerns include the ability to excavate in wetlands, the moisture content of the excavated materials, the load bearing strength of the soils being excavated (will they support construction equipment), sedimentation effects on areas not selected for active remediation, transporation and disposal of Class III materials, development of an adequate solidification/stabilization process, development of a monofill, and development of proposed action levels for the environmental monitoring program.

Several excavation techniques are available that can excavate the contaminated wetland materials. A combination of bulldozers, clamshells, frontend loaders, and dump trucks can be used for excavation. In order to minimize technical problems associated with excavation, these activities should be scheduled for the dry season. This may increase the fugitive dust problem; however, this can be controlled by sprinkling or other dust control measures. Excavation during the dry seasons will also minimize the potential problem of free liquids in the contaminated soils. Sedimentation effects on adjacent areas can be controlled by existing technology.

Transportation of contaminated materials to the monofill would be by truck, which is a proven technology. The loss of contaminated materials will be minimized through the use of liners and covers. In addition, the contaminants would be immobilized in the soil by the solidification/stabilization process.

Disposal of solidified/stabilized soils in a monofill located on NWS Concord may raise technical concerns over the long term durability of such materials. Because of these concerns and the results of the geological investigations conducted by Lutton et. al. (1987) any monofill constructed on NWS Concord should be designed to meet Class I engineering standards. Use of Class I

engineering standards, combined with the relatively limited mobility of metals, would provide long term security for disposal of the solidified/ stabilized materials. Note, however, that none of the available monofill sites on NWS Concord meet Class I siting requirements (Lutton et. al. 1987).

Solidification/stabilization of wastes containing high levels of heavy metals has been demonstrated; however, the process must be developed on a site specific basis. Implementation of a solidification/stabilization technology in California is complicated by the two phase test procedure (TTLC/STLC) and the use of a citric acid extraction that is substituted for the acetic acid extraction of the U.S. EPA's Extraction Procedure. Solidification/ stabilization does not remove the metals. Other than for the dilution effects caused by adding large amounts of binder, the TTLC is essentially unchanged. The citric acid extraction is generally believed to be more rigorous than the acetic acid extraction and the data base for successful solidification/ stabilization when using a citric acid extraction is limited. Discussions with State of California regulatory personnel (Tornatele 1988) indicated that some success has been demonstrated in reducing the STLC and that special waivers of the TTLC requirement may be made when solidification/ stabilization is implemented.

The proposed environmental monitoring techniques are standard engineering and scientific practices that can be executed without project delay. Care must be taken to ensure that the sample size for the biological monitoring is sufficient and organized in such a way as to allow evaluation of a statistical significance. Difficulties may be encountered in the development of proposed action levels; however, these difficulties are not expected to present a major obstacle to execution of this alternative.

Costs. The present worth cost of Alternative 1-3D is anticipated to be approximately $4,900,000. These costs are substantially greater than the no action or monitoring alternative. Alternative 1-3D provides substantial positive remediation of the contaminated area on RASS 1. In addition, solidification/stabilization decreases the possibility that contamination will be mobilized in the future.

5.2.1.7 Alternative 1-3E: Excavation/Soil Washing/Disposal at Existing Landfills

Description. This alternative consists of excavation of the contaminated soils and removal of the arsenic and heavy metals by chemical washing (Nash and Tarver 1986). The excavated materials would be classified into Class I, Class II, and Class III wastes. Class I and Class II materials would be treated. The washed soils would be transported to an existing Class III land disposal facility. Soil washing would be accomplished by pumping an aqueous solution of acids, bases, surfactants, chelating agents, or any combination thereof, through a series of three upflow soil column reactors. The contaminated washing solutions would be treated for recycling of the washing agents. The resulting waste sludges would be treated and transported to an existing Class I disposal facility. Major components of this alternative include: excavation, classification, soil washing, transportation of treated soils and sludges to existing disposal facilities of the appropriate class, disposal of the materials in an appropriate class of landfill, and long term monitoring of the remediation area.

Environmental and Public Health Screening. This alternative provides substantial remediation of ecological and health hazards associated with contaminated soils in RASS 1, including possible transport of contaminated materials to other important ecosystems such as Suisun Bay.

Excavation of contaminated material presents the potential for adverse effects caused by exposure of construction personnel and the general public to the excavated materials during transport of the materials to existing disposal facilities. Impacts on the general public from the contaminated soils will be minimized because the contaminants would be removed by the soil washing process. An effluent stream of sludges containing high levels of arsenic and heavy metals would be generated and would require transport to a Class I land disposal facility. The amount of sludge is estimated to be twenty percent of the volume of treated soil. Fugitive dust may be a problem; however, this can be minimized through proper planning and design.

The excavation of contaminated materials will also impact the important wetland habitats found in RASS 1 and would impact resident wildlife populations by death or displacement. Over time, however, the area of excavation will tend to silt in and the vegetation would recover. Uncertainty exists in the time required for silting and vegetation to recover. The probability that a pickleweed wetland will eventually establish naturally is low and the uncertainty is high. Consequently, natural recovery of suitable habitat for the protected species will more than likely have a low probability of success. In the short term, the habitat will be either a mudflat or standing water, depending on the final elevation and drainage patterns. Neither of these types of habitat would provide habitat for the protected species currently on-site (Lee et al. 1986). These short term impacts would be offset by the potential for long term recovery of the area once the contaminated materials have been removed.

Anticipated short term impacts can be minimized by proper planning of construction activities. For example, major construction activities can be timed to avoid the months when the highest level of reproductive activity occurs.

Trucks would be used for transporting the treated soils to land disposal facilities. Either truck or rail would be used to transport the residual sludges to Class I disposal facilities. Therefore, the disposal of residual sludge materials has the additional risk of exposure of the general public to contaminated materials during transport of these materials to the disposal facilities. Although the trucks would be lined and covered, passage of the trucks through towns and communities would raise community concerns. Additional truck traffic would cause noise pollution and a possible increase in accidents, which could cause loss of life, air pollution, and increased exposure to spilled contaminated materials. Since the soil washing process removes and concentrates contaminants, the potential exposure to contaminated materials should be reduced.

Alternative 1-3E provides long term environmental protection at the expense of significant short term impacts. In the long term, natural regrowth of vegetation may offset any short term impacts. However, there is a low probability

that the habitat would be suitable for the protected species currently inhabiting RASS 1.

Engineering Feasibility. Except for the soil washing technology, the technologies proposed for implementation under Alternative 1-3E are standard engineering and scientific practices. The overriding technical concern associated with this alternative is development of a soil washing process. Other technical concerns include the ability to excavate in wetlands, the moisture content of the excavated materials, the load bearing strength of the soils being excavated (will they support construction equipment), sedimentation effects on areas not selected for active remediation, transportation and disposal of Class III materials, transportation and disposal of Class I materials, and development of proposed action levels for the environmental monitoring program.

Several excavation techniques are available that can be used to excavate the contaminated wetland materials. A combination of bulldozers, clamshells, frontend loaders, and dump trucks can be used for excavation. In order to minimize technical problems associated with excavation, these activities should be scheduled for the dry season. This may increase the fugitive dust problem; however, this can be controlled by sprinkling or other dust control measures. Excavation during the dry seasons will also minimize the potential problem of free liquids in the contaminated soils. Sedimentation effects on adjacent areas can be controlled by existing technology such as silt barriers or silt screens.

Although it is expected that the cleaned soils will be suitable for unrestricted use, for cost estimating purposes, it is assumed that the materials will be disposed of in a Class III landfill. Transportation of decontaminated materials to existing landfills would be by truck, which is a proven technology. The loss of materials will be minimized through the use of liners and covers. Since it is expected that the decontaminated soils will be suitable for unrestricted use, materials loss would not be a critical technical issue. The sludge produced by the soil washing process would be transported to an existing Class I facility by truck or rail. Both truck and rail

transportation of contaminated soils are proven technologies. The loss of contaminated materials will be minimized through the use of liners and covers.

Although demonstrated to some degree in the mining and ore processing industry, soil washing for removal of arsenic and heavy metals from contaminated soils has not been proven in a large scale remedial action. The process is developmental and would require additional laboratory and pilot scale study before implementation on a scale of the proposed remedial action for RASS 1. Personnel communications (Tetra Resources 1988, Environmental Field Services 1988, OH Materials 1987, USEPA 1987) indicates conflicting opinions on the technical feasibility of soil washing. If the soil washing process proves to be technically feasible, two waste streams are produced: the decontaminated soils and a sludge containing the heavy metals removed from the soil. It is assumed that the soil will be cleaned sufficiently for unrestricted use; however, the sludge containing the heavy metals will be a Class I and possibly a RCRA waste.

The proposed environmental monitoring techniques are standard engineering and scientific practices that can be executed without project delay. Care must be taken to ensure that the sample size for the biological monitoring is sufficient and organized in such a way as to allow evaluation of a statistical significance. Difficulties may be encountered in the development of proposed action levels; however, these difficulties are not expected to present a major obstacle to execution of this alternative.

Costs. The present worth cost of Alternative 1-3E is anticipated to be approximately $6,425,000. These costs are substantially greater than the no action or environmental monitoring alternative. Alternative 1-3E would provide substantial positive remediation of the contaminated area on RASS 1. Contaminants would be removed from large volumes of soil and concentrated in a reduced volume.

5.2.1.8 Alternative 1-3F: Excavation/Soil Washing/Disposal at Monofill on NWS Concord

Description. This alternative consists of excavation of the contaminated soils and removal of the contamination by chemical washing (Nash 1986). The washed soils would be transported to a Class III monofill constructed on NWS Concord. Soil washing would be accomplished by pumping an aqueous solution of acids, bases, surfactants, chelating agents, or any combination thereof, through a series of three upflow soil column reactors. The contaminated washing solutions would be treated for recycling of the washing agents. The resulting waste sludges would be treated and transported to an existing Class I disposal facility. Major components of this alternative include: excavation, soil washing, transportation of treated soils to a Class III monofill located on NWS Concord, transportation of residual sludges to an existing Class I landfill, disposal of the materials in an appropriate class of landfill, long term monitoring of the remediation area, and long term monitoring of the monofill.

Environmental and Public Health Screening. This alternative provides complete remediation of ecological and health hazards associated with contaminated soils in RASS 1, including possible transport of contaminated materials to other important ecosystems such as Suisun Bay.

Excavation of contaminated materials presents the potential for adverse effects caused by exposure of construction personnel and persons located on NWS Concord to the excavated materials during transport of the materials to the monofill. Impacts on the general public from the contaminated soils will be minimized because the contaminants would be removed by the soil washing process and the decontaminated materials would be disposed of on NWS Concord. An effluent stream of contaminated sludges would be generated that would require transport to a Class I land disposal facility. The quantity of sludge is estimated to be twenty percent of the treated soils. Fugitive dust may be a problem; however, this can be minimized through proper planning and design.

The excavation of contaminated materials will also impact the important wetland habitat found in RASS 1 and would impact resident wildlife populations by

death or displacement. Over time, however, the area of excavation will tend to silt in and the vegetation would recover. Uncertainty exists in the time required for silting and vegetation to recover. The probability that a pickleweed wetland will eventually establish naturally is low and the uncertainty is high. Consequently, natural recovery of suitable habitat for the protected species will more than likely have a low probability of success. In the short term, the habitat will be either a mudflat or standing water, depending on the final elevation and drainage patterns. Neither of these types of habitat would provide habitat for the protected species currently on-site (Lee et al. 1986). These short term impacts would be offset by the potential for long term recovery of the area once the contaminated materials have been removed.

Anticipated short term impacts can be minimized by proper planning of construction activities. For example, major construction activities can be timed to avoid the months when the highest level of reproductive activity occurs.

Trucks would be used for transporting the treated soils to the monofill. The disposal of the decontaminated materials on NWS Concord reduces the risk of exposure of the general public to contaminated materials during transport of these materials to the disposal facilities. Sludges generated by the soil washing process would be transported by truck or rail to existing Class I disposal facilities. Although the trucks would be lined and covered, passage of the trucks through NWS Concord and surrounding communities may raise community concerns. Additional truck traffic would cause noise pollution and a possible increase in accidents, which could cause loss of life, air pollution, and increased exposure to spilled contaminated materials.

Alternative 1-3F provides long term environmental protection at the expense of rather severe short term impacts. In the long term, natural regrowth of vegetation may offset any short term impacts. However, there is a low probability that the habitat would be suitable for the protected species currently inhabiting RASS 1.

Engineering Feasibility. Except for the soil washing technology, the technologies proposed for implementation under Alternative 1-3F are standard

engineering and scientific practices. The overriding technical concern associated with this alternative is development of a soil washing process. Other technical concerns include the ability to excavate in wetlands, the moisture content of the excavated materials, the load bearing strength of the soils being excavated (will they support construction equipment), sedimentation effects on areas not selected for active remediation, transportation and disposal of Class III materials, transportation and disposal of Class I materials, and development of proposed action levels for the environmental monitoring program.

Several excavation techniques are available that can be used to excavate the contaminated wetland materials. A combination of bulldozers, clamshells, frontend loaders, and dump trucks can be used for excavation. In order to minimize technical problems associated with excavation, these activities should be scheduled for the dry season. This may increase the fugitive dust problem; however, this can be controlled by sprinkling or other dust control measures. Excavation during the dry seasons will also minimize the potential problem of free liquids in the contaminated soils.

Although it is expected that the cleaned soils will be suitable for unrestricted use, for cost estimating purposes, it is assumed that the materials will be disposed of in a Class III landfill on NWS Concord. Transportation of decontaminated materials to the monofill would be by truck, which is a proven technology. The loss of materials will be minimized through the use of liners and covers. Since it is expected that the decontaminated soils will be suitable for unrestricted use, materials loss would not be a critical technical issue. The sludge produced by the soil washing process would be transported to an existing Class I facility by truck or rail. Both truck and rail transportation of contaminated soils are proven technologies. The loss of contaminated materials will be minimized through the use of liners and covers.

Although demonstrated to some degree in the mining and ore processing industry, soil washing for removal of arsenic and heavy metals from contaminated soils has not been proven in a large scale remedial action. The process is developmental and would require additional laboratory and pilot scale study before implementation on a scale of the proposed remedial action for RASS 1.

Personnel communications (Tetra Resources 1988, Environmental Field Services 1988, OH Materials 1987, USEPA 1987) indicates conflicting opinions on the technical feasibility of soil washing. If the soil washing process proves to be technically feasible, two waste streams are produced: the decontaminated soils and a sludge containing the heavy metals removed from the soil. It is assumed that the soil will be cleaned sufficiently for unrestricted use; however, the sludge containing the heavy metals will be a Class I and possibly a RCRA waste.

The proposed environmental monitoring techniques are standard engineering and scientific practices that can be executed without project delay. Care must be taken to ensure that the sample size for the biological monitoring is sufficient and organized in such a way as to allow evaluation of statistical significance. Difficulties may be encountered in the development of proposed action levels; however, these difficulties are not expected to present a major obstacle to execution of this alternative.

Costs. The present worth cost of Alternative 1-3F is anticipated to be approximately $7,329,000. These costs are substantially greater than the no action and environmental monitoring alternatives. Alternative 1-3F would provide substantial positive remediation of the contaminated area in RASS 1. Contaminants would be removed from large volumes of soil and concentrated in a reduced volume.

5.2.1.9 Alternative 1-4A: Capping with Soil Cover

Description. This alternative examines the use of a topsoil/vegetative cover to reduce the possibility of erosion and direct contact with the contaminated soil materials. The contaminated soil materials located in RASS 1 would not be removed. The primary components of this alternative include: site preparation, placement of a soil cover, grading, vegetation of the cover, and long term monitoring.

Environmental and Public Health Screening. This alternative would substantially eliminate the potential for exposure of biota or humans through direct contact with the highly contaminated surficial soils, and it would prevent

resuspension and redistribution of the contaminated soils into adjacent uncontaminated or lightly contaminated areas. Furthermore, migration of contaminants into Suisun Bay would be prevented. Prevention of biota contact with the contaminated soils would prevent food chain transfer of the contaminants to humans and reduce or eliminate potential health effects of concern.

Although the implementation of the soil cap would prevent further migration of contaminants into adjacent areas, there would be long term adverse impacts associated with raising the natural elevation of wetland areas in RASS 1. The top soil cover would raise the ground elevation a minimum of 4 ft. Portions of important wetlands found in RASS 1 would be converted into upland and a transition zone. Regulatory issues would be raised with any proposal to fill and destroy wetlands with a resultant loss of habitat and harm to endangered species.

Engineering Feasibility. The technologies proposed for implementation under Alternative 1-4A are standard engineering and scientific practices. Technical concerns include the ability to construct a soil cap on the wetland, the load bearing strength of the soils on which the cap would be constructed (will they support the cap without excessive long term maintenance), sedimentation and compaction effects on areas not selected for active remediation, establishment and maintenance of a vegetative cover, and development of proposed action levels for the environmental monitoring program.

Construction of the soil cap will be similar to a filling operation, which is a proven technology. Adequate geotechnical design and vegetation establishment procedures are available to ensure that the cap is durable and performs its intended purpose.

Sedimentation effects on adjacent areas can be controlled by existing technology.

The environmental monitoring techniques are standard engineering and scientific practices that can be executed without project delay. Care must be taken to ensure that the sample size for the biological monitoring is sufficient and organized in such a way as to allow evaluation of statistical

significance. Difficulties may be encountered in the development of proposed action levels; however, these difficulties are not expected to present a major obstacle to execution of this alternative.

Costs. The present worth of Alternative 1-4A is anticipated to be approximately $2,800,000.

5.2.1.10 Alternative 1-4B: Source Isolation/RCRA Cap

Description. This alternative examines the use of a multilayered cover (RCRA cap) to reduce the possibility of erosion and direct contact with the contaminated soil material. The contaminated soil materials located in RASS 1 would not be removed. The primary components of this alternative include: site preparation, placement of a cover meeting RCRA requirements, grading, and vegetation of the cover. At a minimum, the RCRA cap would include a 2 ft thick low permeability (10^{-7}) soil layer, a 12 in. drainage layer, a 20 mil synthetic membrane with bedding, and a 2 ft layer of topsoil. Finally, the cover would be graded and vegetated. A cross-section of a typical RCRA cap is illustrated in Plate 5.3. Final cap specifications would be coordinated with appropriate regulatory agencies.

Environmental and Public Health Screening. This alternative would substantially eliminate the potential for exposure of biota or humans to direct contact with the highly contaminated surficial soils, and it would prevent resuspension and redistribution of the contaminated soils into adjacent uncontaminated or slightly contaminated areas. Furthermore, migration of contaminants into Suisun Bay would be prevented. Prevention of biotic contact with the contaminated soils would prevent food chain transfer of the contaminants to humans and reduce or eliminate potential health effects of concern. Implementation of the RCRA cap alternative would also reduce the potential for transport of contamination into the underlying groundwater.

Although the implementation of the RCRA cap would prevent further migration of contaminants into adjacent areas and ground water, there would be long term adverse impacts associated with raising the natural elevation of RASS 1. The RCRA cover would raise the ground elevation a minimum of 6 ft. Portions of

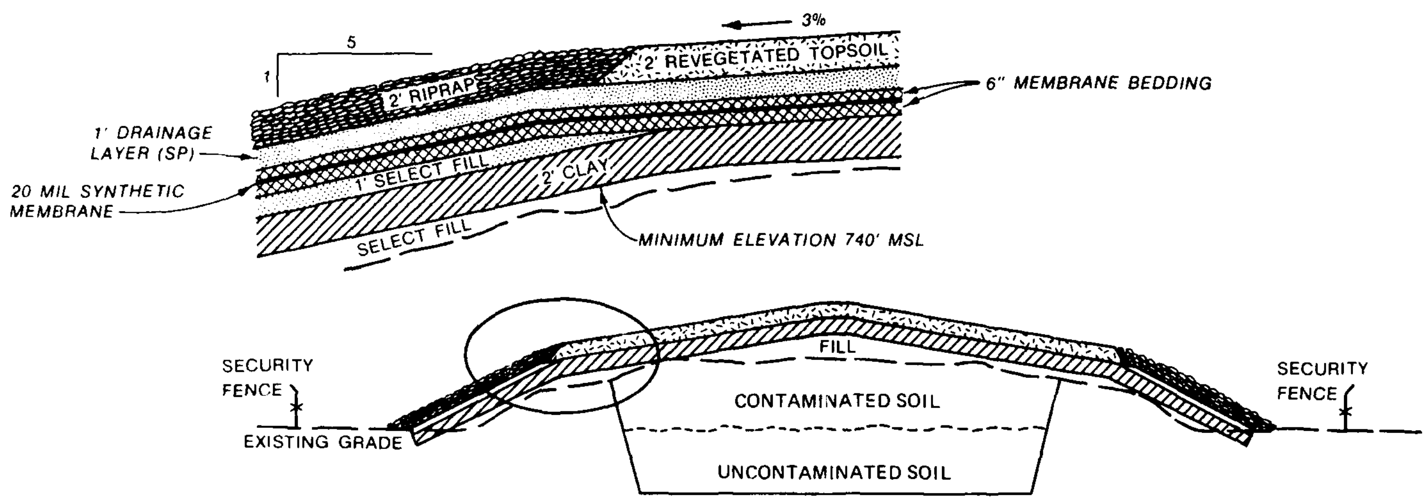


Plate 5.3. Typical concept for a RCRA cap.

important wetlands found in RASS 1 would be converted into upland and a transition zone. Regulatory issues would be raised with any proposal to fill and destroy wetlands with a resultant loss of habitat and harm to endangered species.

Engineering Feasibility. The technologies proposed for implementation under Alternative 1-4B are standard engineering and scientific practices. Technical concerns include the ability to construct a RCRA cap on the wetland, the load bearing strength of the soils on which the cap would be constructed (will they support the cap without excessive long term maintenance), sedimentation and compaction effects on areas not selected for active remediation, establishment of a vegetative cover, and development of proposed action levels for the environmental monitoring program.

Construction of the RCRA cap will be similar to a filling operation, which is a proven technology. Adequate geotechnical design and vegetation establishment procedures are available to ensure that the cap is durable and performs its intended purpose. Sedimentation effects on adjacent areas can be controlled by existing technology.

The environmental monitoring techniques are standard engineering and scientific practices that can be executed without project delay. Care must be taken to ensure that the sample size for the biological monitoring is sufficient and organized in such a way as to allow evaluation of statistical significance. Difficulties may be encountered in the development of proposed action levels; however, these difficulties are not expected to present a major obstacle to execution of this alternative.

Costs. The present worth cost of Alternative 1-4B is anticipated to be approximately $3,900,000.

5.2.1.11 Alternative 1-5A: On-Site Restoration

Description. Whereas site remediation emphasizes the cleanup of a release of contaminated materials, site restoration is the return of environmental conditions to a pre-existing condition or enhancement of the current

environmental condition. Restoration may be required by ARAR's. In most cases, it is expected that restoration activities would be much more costly than implementation of remedial action alternatives. However, at NWS Concord there appears to be an opportunity to combine remediation activities and environmental restoration with only a minimal increase in the cost of the underlying remediation activities. Alternative 1-5A incorporates the concept of full restoration of RASS 1. Implementation of Alternative 1-5A assumes implementation of one of the excavation alternatives (Alternative 1-3A through 1-3F) with an add-on restoration element. A detailed restoration plan would be developed as part of this alternative. The restoration plan would give particular attention to acquiring and planting plant species of vegetation normally found in the wetland areas of RASS 1. The emphasis of wetland restoration would be to provide habitat for the salt marsh harvest mouse.

Environmental and Public Health Screening. In the long term, the goal of restoration is to minimize the environmental effects of contamination and remedial action. This alternative provides substantial remediation of ecological and health hazards associated with contaminated soils in RASS 1, including possible transport of contaminated materials to other important ecosystems such as Suisun Bay. In addition, contaminated areas in RASS 1 would be restored to productive wetland in the shortest practicable time period.

Excavation presents the potential for adverse effects caused by exposure of construction personnel and persons located off-site to the excavated materials during transport of the materials to disposal facilities. The excavation of contaminated materials will also impact the important wetland habitat found in RASS 1 and would impact resident wildlife populations by death or displacement. Recovery would be expedited through implementation of an active wetland restoration program.

Anticipated short term impacts can be minimized by proper planning of construction activities. For example, major construction activities can be timed to avoid the months when the highest level of reproductive activity occurs.

Trucks or rail cars would be used for transporting contaminated or treated soils to land disposal facilities. If existing landfills were selected as the final disposal site, there is risk of exposure of the public to contaminated materials during transport of these materials to the disposal facilities. Although the trucks or rail cars would be lined and covered, passage through towns and communities would raise community concerns. Additional truck traffic would cause noise pollution and a possible increase in accidents, which could cause loss of life, air pollution, and increased exposure to spilled contaminated materials. Implementation of a disposal alternative that includes construction of a landfill on NWS Concord would limit these impacts to NWS Concord and public transportation corridors traversing NWS Concord.

Alternative 1-5A provides long term environmental protection at the expense of rather severe short term impacts. These short term impacts are minimized by the active restoration of the excavated areas. Since contamination is removed from the wetland environment and the wetland is returned to pre-existing conditions in the shortest possible timeframe, on-site restoration provides the greatest level of environmental protection of any alternative considered.

Engineering Feasibility. The technologies proposed for implementation under Alternative 1-5A are standard engineering and scientific practices that can be executed without project delay. Excavation of contaminated materials from wetlands may present problems in execution of this alternative. Primary technical concerns include the ability to excavate in wetlands, the moisture content of the excavated materials, the load bearing strength of the soils being excavated (will they support construction equipment), sedimentation and effects on areas not selected for active remediation, transportation and disposal of contaminated or treated materials, and wetland restoration. Difficulties may also be encountered in the development of proposed action levels.

Several excavation techniques are available that can excavate the contaminated wetland materials. A combination of bulldozers, clamshells, frontend loaders, and dump trucks can be used for excavation. In order to minimize technical problems associated with excavation, excavation activities should be scheduled for the dry season. This may increase the fugitive dust problem; however, this can be controlled by sprinkling or other dust control measures.

Excavation during the dry season will also minimize the potential problem of free liquids in the contaminated soils.

Transportation of contaminated or treated materials to existing landfills or to a monofill located on NWS Concord would be by truck or rail. Both truck and rail transportation of contaminated soils are proven technologies. The loss of contaminated materials will be minimized through the use of liners and covers.

Disposal of contaminated soils in a Class I landfill is a proven technology. Although there are technical concerns over the possibility that the landfill will leak, these concerns are usually addressed through the implementation of siting controls and engineered features such as liners and leak detection systems. There are several Class I landfills in operation that can accept the types of materials that will be excavated from RASS 1. No available monofill sites on NWS Concord meet siting requirements for a Class I facility. Concerns over the long term durability of solidified/stabilized materials require the disposal of such materials in a facility engineered to Class I standards.

Although some uncertainty exists in wetland restoration, several factors would enhance the probability of success of this alternative. Recommendations for specific objectives and plans for monitoring would be followed. Regional goals, i.e., interest in the salt marsh harvest mouse and two species of rail, are clear, leading to the objective of restoration of a pickleweed marsh and associated transition zone vegetation. The detailed restoration plan would be written in concert with local experts in wetland restoration and rely heavily on guidelines for local conditions such as those found in Josselyn and Buchholz (1982). Because long term monitoring is an integral part of the restoration plan, adequate provisions would be developed to monitor execution and progress of the restoration and to allow corrective action if necessary.

The environmental monitoring techniques are standard engineering and scientific practices that can be executed without project delay. Care must be taken to ensure that the sample size for the biological monitoring is sufficient and organized in such a way as to allow evaluation of statistical

significance data base. Difficulties may be encountered in the development of proposed action levels; however, these difficulties are not expected to present a major obstacle to execution of this alternative.

Costs. The present worth cost of Alternative 1-5A is anticipated to be approximately $4,763,000.

5.2.1.12 Alternative 1-5B: Off-Site Restoration

Description. This alternative incorporates the remediation of contamination in RASS 1 using one of the capping alternatives (Alternatives 1-4A or 1-4B) with off-site mitigation for the loss of wetland areas. The contaminated area in RASS 1 would be capped and an appropriate quantity of land would be permanently set aside as wetland. In another option, agricultural land could be obtained and converted to wetland.

Environmental and Public Health Screening. This alternative will substantially eliminate the potential for exposure of biota or humans through direct contact with the highly contaminated surficial soils, and it would prevent resuspension and redistribution of the contaminated soils into adjacent uncontaminated or slightly contaminated areas. Furthermore, migration of contaminants into Suisun Bay would be prevented. Prevention of biotic contact with the contaminated soils would prevent transfer of the contaminants to humans and reduce or eliminate potential health effects of concern.

Although the implementation of the top soil cap would prevent further migration of contaminants into adjacent areas, there would be long term adverse impacts associated with raising the natural elevation of RASS 1. The top soil cover would raise the ground elevation a minimum of 4 ft. Portions of important wetlands found in RASS 1 would be converted into upland and a transition zone. Regulatory issues would be raised with any proposal to fill and destroy wetlands with a resultant loss of habitat and harm to endangered species. The loss of wetlands will be mitigated by the acquisition of off-site wetlands or the acquisition of lands that will be converted into wetlands.

Engineering Feasibility. The technologies proposed for implementation under Alternative 1-5B are standard engineering and scientific practices that can be executed without project delay. Technical concerns include the ability to construct a soil or RCRA cap on the wetland, the load bearing strength of the soils on which the cap would be constructed (will they support the cap without excessive long term maintenance), sedimentation and compaction effects on areas not selected for active remediation, restoration of wetlands, and development of proposed action levels for the environmental monitoring program.

Construction of the soil or RCRA cap will be similar to a filling operation, which is a proven technology. Adequate geotechnical and vegetation design procedures are available to ensure that the cap is durable and performs its intended purpose. Sedimentation and compaction effects on adjacent areas can be controlled by existing technology.

Difficulties may be encountered in acquiring suitable wetlands offsite. It would be necessary to acquire wetlands as close to NWS Concord as possible because of the limited distribution of the salt marsh harvest mouse, the primary focus of the mitigation actions. A large portion of such wetlands are diked, which reduces their value for the mouse, and many wetlands are already in public ownership. The quantity of land that would be required and its potential availability have not been determined.

If existing wetlands are not available, another option is to acquire land in other categories of use, e.g., agriculture, and create wetlands. This can be accomplished by breaching dikes and restoring tidal flow, depositing dredged material on shallow water areas, or moving upland soils into tidal influence.

Although uncertainty exists in conversion of agricultural land to wetland, several factors would act to increase the probability of success of this alternative. Recommendations for specific objectives and plans for monitoring would be followed. The detailed restoration plan would be written in concert with local experts in wetland restoration and rely heavily on guidelines for local conditions such as those found in Josselyn and Buchholz (1982). Because long term monitoring is an integral part of the restoration plan, adequate

provisions would be developed to monitor execution and progress of the restoration and to allow corrective action as necessary.

The environmental monitoring techniques are standard engineering and scientific practices that can be executed without project delay. Care must be taken to ensure that the sample size for the biological monitoring is sufficient and organized in such a way as to allow evaluation of statistical significance. Difficulties may be encountered in the development of proposed action levels; however, these difficulties are not expected to present a major obstacle to execution of this alternative.

Costs. The present worth cost of Alternative 1-5B is anticipated to be approximately $3,216,000.

5.2.1.13 Alternative 1-6A: In Situ Stabilization

Description. The in situ stabilization alternative consists of injecting the in place contaminated soils with chemical reagents to immobilize the contaminants in the soil. The process is similar to the excavation/immobilization alternatives (Alternative 1-3C and 1-3D), except that the binder chemicals are mixed with the inplace soils and the contaminated soils are not excavated. The major components of this alternative include: development of a solidification/stabilization process, stripping of vegetation, application of the solidification/stabilization binder, revegetation, periodic reapplication of the binder, and long term environmental monitoring of the remediation area.

Environmental and Public Health Screening. This alternative provides limited remediation of the ecological and health hazards associated with the contaminated soils in RASS 1. The primary mechanism of the in situ stabilization process is to reduce the solubility of the metals and thereby reduce their bioavailability. The in situ immobilization process does not remove the metals from the soils. Metals would be available to migrate with any soil or sediment that is physically moved by hydrologic processes. Because of the dynamic hydrologic environment of RASS 1, it is probable that continued migration of contaminants would occur.

Since the metals would remain in the soil, the potential for direct contact would remain. In situ stabilization would reduce the availability of the contaminants.

Because physical migration would be likely, mere chemical stabilization of the soils would not be totally effective in reducing contaminant migration. The soils could be physically stabilized by adding sufficient binder materials; however, addition of binder materials in the quantities required for physical stabilization would most probably have environmental consequences similar to the capping alternatives, i.e, the nature of the habitat would be substantially changed and would probably not support the species currently living on the site.

In situ stabilization requires periodic reapplication of binder materials, so there would be a continued presence in RASS 1. It is estimated that reapplication of binder materials would be necessary every five to ten years. Reapplication would involve similar activities to the initial application. Because of the maintenance requirements, adverse impacts of the in situ stabilization alternative would be long term and continuing.

Although there is some potential for remediation, any remediation is off set by the requirement to periodically reapply the binder agents to RASS 1. This alternative would have severe short term impacts as well as major long term adverse impacts on vegetation and wildlife that try to colonize the RASS.

Engineering Feasibility. Primary technical concerns include the ability to apply binder materials in wetlands, the load bearing strength of the soils (will they support construction equipment), sedimentation and compaction effects on areas not selected for active remediation, development of a solidification/stabilization process that can be applied in situ in the wetlands. Difficulties may also be encountered in the development of proposed action levels.

The primary technology, in situ stabilization, proposed for implementation in this alternative has not been demonstrated on a large scale, nor has it been applied in a wetland environment. Although the technology is similar to

solidification/stabilization technology used in the excavation/immobilization alternatives, the excavation alternatives have the advantage that the materials are removed from an active hydrologic environment and the solidification/stabilization processing is accomplished in a controlled environment. Of particular technical concern to this alternative is the long term durability of the treated soils in an active hydrologic environment. Since the in situ stabilization process is oriented towards the chemical immobilization of contaminants, it is likely that physical mobilization will continue.

Solidification/stabilization of wastes containing high levels of heavy metals has been demonstrated; however, the process must be developed on a site specific basis. In situ stabilization in a wetland environment has not been demonstrated. Implementation of a solidification/stabilization technology in California is complicated by the two phase test procedure (TTLC/STLC) and the use of a citric acid extraction that is substituted for the acetic acid extraction of the U.S. EPA's EP.

Solidification/stabilization does not remove the metals, and other than the dilution effects caused by adding large amounts of binder, the TTLC is essentially unchanged. The citric acid extraction is generally believed to be more rigorous than the acetic acid extraction and the data base for successful solidification/stabilization when using a citric acid extraction is limited. Discussions with State of California regulatory personnel (Tornatele 1988) indicated that some success has been demonstrated in reducing the STLC and that special waivers of the TTLC requirement can be obtained when solidification/stabilization is implemented. The potential technical problems are compounded in this alternative because the alternative leaves the treated materials in an active environment rather than placing them in a controlled landfill environment.

The proposed environmental monitoring techniques are standard engineering and scientific practices that can be executed without project delay. Care must be taken to ensure that the sample size for the biological monitoring is sufficient and organized in such a way as to allow for evaluation of statistical significance. Difficulties may be encountered in the development of proposed

action levels; however, these difficulties are not expected to present a major obstacle to execution of this alternative.

Overall, because of site specific reasons, the engineering feasibility of this alternative is low.

Costs. The present worth costs of Alternative 1-6A is estimated to be $3,927,00.

5.2.1.14 Alternative 1-6B: Soil Flushing

Description. The soil flushing alternative consists of injecting a soil washing solution to dislodge, solubilize, or other wise remove the contaminants from the soils. Chemically, the soil flushing alternative is similar to the soil washing alternatives (Alternative 1-3E and 1-3F). Possible flushing agents include water, acids, bases, chelating agents, and/or surfactants. The major components of this alternative include: development of a soil washing process that is effective for the contaminants found on RASS 1, construction of a flushing agent application and recovery system, application and recovery of the soil flushing agents, treatment of the recovered soil flushing agents, disposal of residual sludges and flushing agents, and environmental monitoring of the remediation area.

Environmental and Public Health Screening. This alternative provides substantial remediation of ecological and health hazards associated with the contaminated soils in RASS 1, including possible transport of contaminated materials to other important ecosystems such as Suisun Bay.

The soil flushing process produces an effluent stream of sludges that will be classified as Class I and possibly RCRA wastes. The amount of sludge would be similar to that produced in the soil washing alternatives and is estimated to be approximately 20 percent of the treated soils. The residual sludges would be transported to an existing Class I landfill for disposal. Lined and covered trucks or rail cars would be the primary means of transport. Transport of these materials has the additional risk of exposure of the general public to contaminated materials. Passage of the trucks and rail cars through

populated areas may raise community concerns. Additional traffic would cause noise pollution, and a possible increase in accidents, which could cause loss of life, air pollution, and increased exposure to contaminated materials.

The construction of soil flushing reagent application and recovery system would cause severe short term disruption of the habitat in RASS 1. Anticipated short term impacts could be minimized by proper planning of construction activities; however, since the application and recovery of the soil flushing reagents may take several seasons, short term impacts may occur for a substantial period of time.

In addition to the disruption caused by construction activities, some soil flushing reagents may be toxic or hazardous. Since 100 percent recovery of the soil flushing reagents is unlikely, soil flushing may have a detrimental impact on the plant and wildlife in RASS 1.

Alternative 1-6B provides long term environmental protection from the existing contamination at the expense of substantial short term impacts and possible long term impacts from the flushing reagents.

Engineering Feasibility. Soil flushing technology is not considered to be a standard engineering or scientific technology for remediation of contaminated sites. The overriding technical concern associated with this alternative is development of a soil flushing process. Other technical concerns include the load bearing strength of the soils (will they support construction equipment), the permeability of the soils (can the flushing agents be recovered), sedimentation effects on areas not selected for active remediation, transportation and disposal of Class I materials, and development of proposed action levels for the environmental monitoring program.

The chemistry of soil flushing is similar to that of soil washing (Alternatives 1-3E and 1-3F). The process is developmental and would require additional laboratory and pilot scale study before implementation on a scale of the proposed remedial action for RASS 1. If the soil flushing process proves to be technically feasible, a sludge containing the heavy metals removed from the soil would require disposal. It is assumed that the soil will be cleaned

sufficiently for unrestricted use; however, the sludge containing the heavy metals will be a Class I and possibly a RCRA waste.

Construction of a flushing agent application and recovery system in the wetland environment will be technically difficult. Although construction could be scheduled for the dry season, the low permeability of the soils would necessitate construction of recovery wells or underdrains at a close interval, thus increasing the cost and making complete recovery of the flushing agents difficult. This may be particularly important since some of the reagents used for soil flushing are hazardous materials.

The proposed environmental monitoring techniques are standard engineering and scientific practices that can be executed without project delay. Care must be taken to ensure that the sample size for the biological monitoring is sufficient and organized in such a way as to allow for evaluation of statistical significance. Difficulties may be encountered in the development of proposed action levels; however, difficulties are not expected to present a major obstacle to execution of this alternative.

The engineering feasibility of the soil flushing alternative is considered to be low.

Costs. The present worth cost of Alternative 1-6B is estimated to be $5,754,000.

5.2.2 Alternatives for Remedial Action Subsite 2. Fourteen potential remedial action alternatives were initially developed for RASS 2. These included the following.

a. Alternative 2-1: No Action
b. Alternative 2-2: Environmental Monitoring
c. Alternative 2-3A: Excavation/Disposal at Existing Landfills
d. Alternative 2-3B: Excavation/Disposal at Monofill on NWS Concord
e. Alternative 2-3C: Excavation/Immobilization/Disposal at Existing Landfills
f. Alternative 2-3D: Excavation/Immobilization/Disposal at Monofill on NWS Concord

g. Alternative 2-3E: Excavation/Soil Washing/Disposal at Existing Landfills

h. Alternative 2-3F: Excavation/Soil Washing/Disposal at Monofill on NWS Concord

i. Alternative 2-4A: Source Isolation/Soil Cap

j. Alternative 2-4B: Source Isolation/RCRA Cap

k. Alternative 2-5A: On-Site Restoration

l. Alternative 2-5B: Off-Site Restoration

m. Alternative 2-6A: In Situ Stabilization

n. Alternative 2-6B: Soil Flushing

5.2.2.1 Alternative 2-1: No Action

Description. The no action alternative involves no additional positive remedial action activities. Soils containing high levels of heavy metals in RASS 2 would be left in place. No additional monitoring would be implemented. Warning signs and public education programs would be used to inform the public about potential hazards. Property records would be annotated to document the location of known and suspected contamination.

Environmental and Public Health Screening. The no action alternative would not measurably change the current likelihood of exposure of aquatic, wetland, and upland biota to high concentrations of arsenic, cadmium, zinc, copper, and lead that were identified in the surface soils and sediments. The possibility of direct human contact with the contaminated sediments would be only minimally reduced with signs and an education program.

Under the no action alternative, contaminants would continue to migrate from the contaminated area through the pathways described in Section 3. The areal extent of contamination would increase and spread from RASS 2 into the surrounding wetlands, including RASS 1, and eventually into Suisun Bay. While the concentrations of heavy metals might be attenuated by natural dilution effects, a wider range of aquatic and wetland biota would be exposed to the contaminants. In addition, the potential for large discharges of sediment sorbed contaminants would continue to exist whenever a storm and/or abnormal

high tide occurs at NWS Concord. Such events would inevitably expose aquatic and wetland biota to higher concentrations of contamination.

On site sampling and subsequent analysis have confirmed that significant quantities of hazardous substances remain in the surface soils (0-12 in.) of RASS 2. In addition, a smaller area of contamination at depths to 36 in. was located. These substances are subjected to environmental stresses from the horizontal flow of surface water over and through the hazardous substances and, to a lesser extent, vertical infiltration of water through the waste and into the ground water and wind generated fugitive dust. It is anticipated that migration of contaminants from RASS 2 through the surface water media would continue in both the near and long term. The potential environmental effects of the no action alternative are described in detail by Lee et al. (1986). The no action alternative does not provide the necessary reduction in endangerment or continued environmental impacts required by the environmental protection goal.

Engineering Feasibility. The technologies proposed for implementation under the No Action alternative are standard engineering practices that can be executed without undue delay.

Costs. The present worth cost of the No Action alternative is estimated to be $56,000.

5.2.2.2 Alternative 2-2: Environmental Monitoring

Description. The monitoring alternative features the no action alternative, i.e., no additional active remediation, augmented by implementation of continued environmental monitoring. Contaminated materials would be left in-place. A two phase environmental monitoring program would be implemented to periodically evaluate the environmental status of RASS 2 and those adjacent areas onto which contaminants are likely to migrate. At a minimum, the increased monitoring program would include surface water sampling, soil and sediment sampling, bioassays, and wildlife and habitat evaluations. Monitoring activities on RASS 2 would be coordinated with similar activities on RASS 1.

Phase 1 monitoring includes the collection and analysis of soil, surface water, and ground water samples. In addition, wildlife and vegetation would be observed and evaluated. Phase 1 monitoring would be conducted annually for the first five years and every five years thereafter.

Phase 2 monitoring is oriented towards the evaluation of contaminant impacts on the biota of RASS 2 and adjacent areas. Phase 2 monitoring would be conducted every two years for the first five years and every five years thereafter. Phase 2 monitoring includes: clam bioaccumulation studies, macroinvertebrate studies, and plant and animal bioaccumulation studies.

Monitoring studies would be summarized in an annual report describing the results of the various sampling programs. The report would also contain an assessment of any physical changes in RASS 2 or adjacent areas, i.e., natural improvement or degradation of habitats, man-made alterations, etc. The report would also make recommendations for implementation of any required active remedial actions.

Environmental and Public Health Screening. The environmental monitoring alternative would not measurably change the likelihood of exposure of aquatic and wetland biota to high concentrations of heavy metals in soil and sediment. The possibility of direct human contact with the contaminated soils would be minimally reduced by posting of contaminated areas and a public education program.

The monitoring program would allow continued migration of arsenic, cadmium, zinc, copper, and lead from the areas of high contaminant concentrations and the areal extent of the contamination would continue to increase. Contamination of RASS 1 by migration of contaminants from RASS 2 would be likely to occur. There would be some attenuation of the high levels of contamination because of dilution effects. The potential environmental effects are essentially the same as the no action alternative and are described in Lee et al. (1986). The threat of contamination of plants and wildlife including endangered species would continue and the potential for exposure would increase as the areal extent of contamination increases.

The monitoring alternative provides only limited positive environmental protection benefits above those provided by the no action alternative. Although the increased monitoring alternative would not eliminate or reduce contamination of soils, surface waters, or sediments by continued migration of contaminants from current high level areas, increased monitoring would provide documentation of contaminant migration and its longer term environmental impact. Wildlife studies would document species use of RASS 2, the contamination levels of collected species, and problems caused by continuous exposure to the hazardous substances. The environmental monitoring program would also provide an early warning of changes in conditions that may increase the potential for substantial environmental damage by continued contaminant release or an unexpected increase in the rate of release.

Engineering Feasibility. The technologies proposed for implementation under this alternative are standard engineering and scientific practices that can be executed without project delay. Care must be taken to ensure that the sample size for the biological monitoring is sufficient and organized in a way to allow for evaluation of statistical significance. Difficulties may be encountered in the development of proposed action levels; however, these difficulties are not expected to present a major obstacle to execution of this alternative.

Costs. The present worth cost of Alternative 2-2 is estimated to be $1,019,000.

5.2.2.3 Alternative 2-3A: Excavation/Disposal at Existing Landfills

Description. The excavation and disposal at existing landfill alternative consists of excavating contaminated materials followed by land disposal at a licensed off-site land disposal facility. The excavated materials will be classified into the appropriate categories (Class I, Class II, and Class III) for disposal in the appropriate level landfill. The major components of this alternative include: excavation of contaminated materials, classification of the contaminated materials, transportation of the contaminated materials to the appropriate existing disposal facility, disposal, and monitoring of the remediation area. The primary means of transportation assumed for planning

purposes is in lined and covered dump trucks with a capacity of approximately 16-18 cubic yards or covered rail cars with a capacity of 64 cubic yards. A survey of disposal facilities is presented in Table 5.1. These facilities have indicated that they are licensed to dispose of the types of waste materials that will be generated by the remediation activities anticipated in RASS 2.

Environmental and Public Health Screening. This alternative would provide substantial remediation of ecological and health hazards associated with contaminated soils in RASS 2, including possible transport of contaminated materials to other important ecosystems such as those found in RASS 1 and Suisun Bay.

Excavation of contaminated soils presents the potential for adverse effects caused by exposure of construction personnel and persons located off-site to the excavated materials during transport of the materials to existing disposal facilities. The excavation of contaminated materials will also impact the important wetland habitats found in RASS 1 and RASS 2 and would impact resident wildlife populations by death or displacement. Uncertainty exists in the time required for silting and vegetation to recover. The probability that a pickleweed wetland will eventually establish naturally is low and the uncertainty is high. Consequently, natural recovery of suitable habitat for the protected species will more than likely have a low probability of success. Over time, however, the area of excavation will tend to silt in and the vegetation would recover. In the short term, the habitat would be either a mudflat or standing water, depending on the final elevation and drainage patterns. Neither of these types of habitat would provide habitat for the protected species currently on-site (Lee et al. 1986). These short term impacts would be offset by the potential for long term recovery of the area once the contaminated materials have been removed.

Anticipated short term impacts can be minimized by proper planning of construction activities. For example, major construction activities can be timed to avoid the months when the highest level of reproductive activity occurs.

Trucks or rail cars would be used for transporting contaminated soils to land disposal facilities. Therefore, the disposal of contaminated materials in existing landfills has the additional risk of exposing the general public to contaminated materials during transport of these materials to disposal facilities. Trucks or rail cars would be lined and covered; however, passage of trucks through towns and communities would raise community concerns. Additional truck traffic would cause noise pollution and a possible increase in accidents, which could cause loss of life, air pollution, and increased exposure to spilled contaminated materials.

Alternative 2-3A provides long term environmental protection at the expense of major short term impacts. In the long term, natural regrowth of vegetation may offset any short term impacts. However, there is a low probability that the habitat would be suitable for the protected species currently inhabiting RASS 2.

Engineering Feasibility. The technologies proposed for implementation under Alternative 2-3A are standard engineering and scientific practices that can be executed without project delay. Excavation of contaminated materials from wetlands may present problems in execution of this alternative. Primary technical concerns include the ability to excavate in wetlands, the moisture content of the excavated materials, the load bearing strength of the soils being excavated (will they support construction equipment), sedimentation effects on areas not selected for active remediation, transporation, and disposal of Class I materials. Difficulties may also be encountered in the development of proposed action levels for the monitoring plan.

Several excavation techniques are available that can excavate the contaminated wetland materials. A combination of bulldozers, clamshells, frontend loaders, and dump trucks can be used for excavation. In order to minimize technical problems, excavation activities should be scheduled for the dry season. This may increase the fugitive dust problem; however, this can be controlled by sprinkling or other dust control measures. Excavation during the dry seasons will also minimize the potential problem of free liquids in the contaminated soils. Sedimentation affects on adjacent areas can be controlled by existing technology.

Transportation of contaminated materials to existing landfills would be by truck or rail. Both truck and rail transportation of contaminated soils are proven technologies. The loss of contaminated materials will be minimized through the use of liners and covers.

Disposal of contaminated soils in a Class I landfill is a proven technology. Although there are usually technical concerns over the possibility that the landfill will leak, these concerns are usually addressed through the implementation siting controls and engineered features such as liners and leak detection systems. There are several Class I landfills in operation that can accept the types of materials that will be excavated from RASS 2.

The environmental monitoring techniques are standard engineering and scientific practices that can be executed without project delay. Care must be taken to ensure that the sample size for the biological monitoring is sufficient and organized in a way to allow for evaluation of statistical significance. Difficulties may be encountered in the development of proposed action levels; however, these difficulties are not expected to present a major obstacle to execution of this alternative.

Costs. The present worth cost of Alternative 2-3A is anticipated to be approximately $3,146,000.

5.2.2.4 Alternative 2-3B: Excavation/Disposal at Monofill on NWS Concord

Description. The excavation and disposal at a monofill on NWS Concord alternative consists of excavating contaminated materials followed by disposal in a land disposal facility located on NWS Concord. Only materials excavated from the remedial action site would be placed in the monofill. The monofill would be constructed to Class I standards. The major components of this alternative include: excavation of contaminated materials, transportation of the contaminated materials to the appropriate disposal site, disposal, long term monitoring of the remediation area, and long term monitoring of the disposal area.

The primary means of transportation assumed for planning purposes is in lined and covered dump trucks with a capacity of approximately 18 cubic yards. A

survey of suitable sites for construction of a disposal facility on the NWS Concord was conducted (Lutton et. al. 1987). Potential sites are shown on Plate 5.3. None of the sites meet State of California siting requirements for a Class I landfill (Lutton et. al. 1987).

Environmental and Public Health Screening. This alternative could provide for substantial remediation of ecological and health hazards associated with contaminated soils in RASS 2, including possible transport of contaminated materials to other important ecosystems such as RASS 1 and Suisun Bay.

Alternative 2-3B presents the potential for adverse effects caused by exposure to the excavated materials of construction personnel and persons located between the area of excavation and disposal during transport of the materials to disposal facilities. The excavation of contaminated materials would also impact the important wetlands found in RASS 2 and would impact resident wildlife populations by death or displacement. Without proper planning and execution of this alternative, RASS 1 could also be impacted. Over time, however, the area of excavation will tend to silt in and the vegetation would recover. Uncertainty exists in the time required for silting and vegetation to recover. The probability that a pickleweed wetland will eventually establish naturally is low and the uncertainty is high. Consequently, natural recovery of suitable habitat for the protected species will more than likely have a low probability of success. In the short term, the habitat will be either a mudflat or standing water, depending on the final elevation and drainage patterns. Neither of these types of habitat would provide habitat for the protected species currently on-site (Lee et al. 1986). These short term impacts would be offset by the potential for long term recovery of the remediation area once the contaminated materials have been removed.

Anticipated short term impacts can be minimized by proper planning of construction activities. For example, major construction activities can be timed to avoid the months when the highest level of reproductive activity occurs.

Trucks would be used for transporting contaminated soils to land disposal facilities. The disposal of contaminated materials on NWS Concord minimizes the risk of exposing the general public to contaminated materials during

transport of these materials to the disposal facilities. The increase in truck traffic would cause noise pollution and a possible increase in accidents, which could cause loss of life, air pollution, and increased exposure to spilled contaminated materials for personnel on NWS Concord and public transportation corridors traversing NWS Concord.

Alternative 2-3B provides long term environmental protection at the expense of major short term impacts. In the long term, natural regrowth of vegetation may offset any short term impacts. However, there is a low probability that the habitat would be suitable for the protected species currently inhabiting RASS 2.

Engineering Feasibility. The technologies proposed for implementation under Alternative 2-3B are standard engineering and scientific practices. Primary technical concerns include the ability to excavate in wetlands, the moisture content of the excavated materials, the load bearing strength of the soils being excavated (will they support construction equipment), sedimentation effects on areas not selected for active remediation, transporation and disposal of Class I materials, and development of proposed action levels.

Excavation of contaminated materials from wetlands may present problems in execution of this alternative. Several excavation techniques are available that can excavate the contaminated wetland materials. A combination of bulldozers, clamshells, frontend loaders, and dump trucks can be used for excavation. In order to minimize technical problems, excavation activities should be scheduled for the dry season. This may increase the fugitive dust problem; however, this can be controlled by sprinkling or other dust control measures. Excavation during the dry seasons will also minimize the potential problem of free liquids in the contaminated soils. Sedimentation effects on adjacent areas can be controlled by existing technology.

Transportation of contaminated materials to the monofill would be by truck, which is a proven technology. The loss of contaminated materials will be minimized through the use of liners and covers.

Disposal of soils containing high levels of heavy metals and arsenic in a Class I landfill is a proven technology. Although there are usually technical concerns over the possibility that the landfill will leak, these concerns are usually addressed through the implementation of siting controls and engineered features such as liners and leak detection systems. An investigation of potential Class I disposal sites on NWS Concord revealed that none of the available sites meet State of California siting requirements for a Class I facility (Lutton 1987). Therefore, the technical feasibility of implementing Alternative 2-3B is doubtful.

The environmental monitoring techniques are standard engineering and scientific practices that can be executed without project delay. Care must be taken to ensure that the sample size for the biological monitoring is sufficient and organized in a way to allow for evaluation of statistical significance. Difficulties may be encountered in the development of proposed action levels; however, these difficulties are not expected to present a major obstacle to execution of this alternative.

Costs. The present worth cost of Alternative 2-3B is estimated to be $3,002,000.

5.2.2.5 Alternative 2-3C: Excavation/Immobilization/Disposal at Existing Landfills

Description. The excavation/immobilization/disposal at existing landfill alternative consists of excavating contaminated materials, immobilization of the contaminants by addition of chemical reagents, land disposal at an existing licensed land disposal facility, and long term monitoring of the remediation area. The excavated materials will be classified into the appropriate categories (Class I, Class II, and Class III). Class I and Class II materials would be treated with chemical reagents to immobilize the contaminants. This process is generally referred to as chemical solidification/stabilization (USEPA 1986a). Typical solidification/stabilization methods include the addition of 25-100 percent by weight of cement, pozzolanic, and/or proprietary materials. It is assumed that this process is capable of immobilizing the contaminants and the materials would be suitable for disposal in a Class III

land disposal facility. The major components of this alternative include: excavation of contaminated materials, classification of the contaminated materials, immobilization of contaminants in Class I and Class II wastes, transportation of the contaminated materials to the appropriate disposal facility, disposal, and implementation of a long term monitoring program. The primary means of transportation assumed for planning purposes is in lined and covered dump trucks with a capacity of approximately 18 cubic yards. A survey of disposal facilities is presented in Table 5.1. These facilities have indicated that they are licensed to dispose of the types of waste materials that will be generated by the remediation activities anticipated in RASS 2.

Environmental and Public Health Screening. This alternative provides substantial remediation of ecological and health hazards associated with contaminated soils in RASS 2, including possible transport of contaminated materials to other important ecosystems such as those found in RASS 1 and Suisun Bay.

Excavation of contaminated materials presents the potential for adverse effects caused by exposure of construction personnel and the general public to the excavated materials during transport of the materials to existing disposal facilities. Impacts on the general public would be minimized because the contaminants would be immobilized in the soil. Fugitive dust may be a problem; however, this can be minimized through proper planning and design. The excavation of contaminated materials will also impact the important wetlands found in RASS 2 and would impact resident wildlife populations by death or displacement. Without proper planning and execution of this alternative, sensitive wetland areas in RASS 1 could also be impacted. Over time, however, the area of excavation will tend to silt in and the vegetation would recover. Uncertainty exists in the time required for silting and vegetation to recover. The probability that a pickleweed wetland will eventually establish naturally is low and the uncertainty is high. Consequently, natural recovery of suitable habitat for the protected species will more than likely have a low probability of success. In the short term, the habitat will be either a mudflat or standing water, depending on the final elevation and drainage patterns. Neither of these types of habitat would provide habitat for the protected species currently on-site (Lee et al. 1986). These short term impacts would be offset by

the potential for long term recovery of the area once the contaminated materials have been removed.

Anticipated short term impacts can be minimized by proper planning of construction activities. For example, major construction activities can be timed to avoid the months when the highest level of reproductive activity occurs.

Trucks would be used for transporting contaminated soils to land disposal facilities. Therefore, disposal of contaminated materials in existing landfills has the additional risk of exposure of the general public to contaminated materials during transport of these materials to the disposal facilities. Although the trucks would be lined and covered, passage of the trucks through towns and communities would raise community concerns. Additional truck traffic would cause noise pollution and a possible increase in accidents, which could cause loss of life, air pollution, and increased exposure to spilled contaminated materials. These concerns would be reduced somewhat because contaminants would be immobilized in the soil.

Alternative 2-3C provides long term environmental protection at the expense of significant short term impacts. In the long term, natural regrowth of vegetation may offset any short term impacts. However, there is a low probability that the habitat would be suitable for the protected species currently inhabiting RASS 2.

Engineering Feasibility. The technologies proposed for implementation under Alternative 2-3C are standard engineering and scientific practices that can be executed without project delay. Primary technical concerns include the ability to excavate in wetlands, the moisture content of the excavated materials, the load bearing strength of the soils being excavated (will they support construction equipment), sedimentation effects on areas not selected for active remediation, transporation and disposal of Class III materials, development of a solidification/stabilization process, and development of proposed action levels for the environmental monitoring program.

Several excavation techniques are available that can excavate the contaminated wetland materials. A combination of bulldozers, clamshells, frontend loaders,

and dump trucks can be used for excavation. In order to minimize technical problems, excavation activities should be scheduled for the dry season. This may increase the fugitive dust problem; however, this can be controlled by sprinkling or other dust control measures. Excavation during the dry seasons will also minimize the potential problem of free liquids in the contaminated soils.

Transportation of contaminated materials to existing landfills would be by truck, which is a proven technology. The loss of contaminated materials would be minimized through the use of liners and covers.

Co-disposal of solidified/stabilized soils in an existing Class III landfill may raise technical concerns over the long term durability of such materials in the Class III environment. Special placement procedures would have to be implemented. Co-disposal may be prohibited by regulatory authorities.

Solidification/stabilization of wastes containing high levels of heavy metals has been demonstrated; however, the process must be developed on a site specific basis. Implementation of a solidification/stabilization technology in California is complicated by the two phase test procedure (TTLC/STLC) and the use of a citric acid extraction that is substituted for the acetic acid extraction of the U.S. EPA's Extraction Procedure. Solidification/stabilization does not remove the metals and other than for the dilution effects caused by adding large amounts of binder, the TTLC is essentially unchanged. The citric acid extraction is generally believed to be more rigorous than the acetic acid extraction and the data base for successful solidification/stabilization when using a citric acid extraction is limited. Discussions with State of California regulatory personnel (Tornatele 1988) indicated that some success has been demonstrated in reducing the STLC and that special waivers of the TTLC requirement can be obtained when solidification/stabilization is implemented.

The proposed environmental monitoring techniques are standard engineering and scientific practices that can be executed without project delay. Care must be taken to ensure that the sample size for the biological monitoring is sufficient and organized in a way for evaluation of statistical significance.

Difficulties may be encountered in the development of proposed action levels; however, these difficulties are not expected to present a major obstacle to execution of this alternative.

Costs. The present worth cost of Alternative 2-3C is estimated to be $2,189,000.

5.2.2.6 Alternative 2-3D: Excavation/Immobilization/Disposal at Monofill on NWS Concord

Description. The excavation/immobilization/monofill disposal option consists of excavating contaminated materials, immobilization of the contaminants by addition of chemical reagents, and land disposal in a monofill located on NWS Concord. The excavated materials will be classified into the appropriate categories (Class I, Class II, and Class III). Class I and Class II materials would be treated with chemical reagents to immobilize the contaminants. This process is generally referred to as chemical solidification/stabilization (USEPA 1986a). Typical solidification/stabilization methods include the addition of 25-100 percent by weight of cement, pozzolanic or proprietary materials: it is assumed that this process is capable of immobilizing the contaminants and the materials will be suitable for disposal in a land disposal facility constructed to Class III standards. The major components of this alternative include: excavation of contaminated materials, classification of the contaminated materials, immobilization of contaminants in Class I and Class II wastes, transportation of the contaminated materials to the disposal site, disposal in a monofill constructed on NWS Concord, long term monitoring of the remediation site, and long term monitoring of the monofill. The primary means of transportation assumed for planning purposes is in lined and covered dump trucks with a capacity of approximately 18 cubic yards.

Environmental and Public Health Screening. This alternative provides for substantial remediation of ecological and health hazards associated with contaminated soils in RASS 2, including possible transport of contaminated materials to other important ecosystems such as those found in RASS 1 and Suisun Bay.

Excavation of contaminated materials presents the potential for adverse effects caused by exposure of construction personnel and persons located on NWS Concord to the excavated materials during transport of the materials to the monofill. Impacts on the general public would be minimized because the contaminants would be immobilized in the soil and the solidified/stabilized soils would be disposed of on NWS Concord. Fugitive dust may be a problem; however, this can be minimized through proper planning and design.

The excavation of contaminated materials would impact the important wetlands found in RASS 2 and would also impact resident wildlife populations by death or displacement. Without proper planning and execution, sensitive areas in RASS 1 could also be impacted. Over time, however, the area of excavation will tend to silt in and the vegetation would recover. Uncertainty exists in the time required for silting and vegetation to recover. The probability that a pickleweed wetland will eventually establish naturally is low and the uncertainty is high. Consequently, natural recovery of suitable habitat for the protected species will more than likely have a low probability of success. In the short term, the habitat will be either a mudflat or standing water, depending on the final elevation and drainage patterns. Neither of these types of habitat would provide habitat for the protected species currently on-site (Lee et al. 1986). These short term impacts would be offset by the potential for long term recovery of the area once the contaminated materials have been removed.

Anticipated short term impacts can be minimized by proper planning of construction activities. For example, major construction activities can be timed to avoid the months when the highest level of reproductive activity occurs.

Trucks would be used for transporting solidified/stabilized soils to the monofill. Although the trucks would be lined and covered, passage of the trucks through populated areas on NWS Concord would raise personnel concerns. Additional truck traffic would cause noise pollution and a possible increase in accidents, which could cause loss of life, air pollution, and increased exposure to spilled contaminated materials. These impacts would be limited to NWS Concord and public transportation corridors traversing NWS Concord.

Alternative 2-3D provides long term environmental protection at the expense of significant short term impacts. In the long term, natural regrowth of vegetation may offset any short term impacts. However, there is a low probability that the habitat would be suitable for the protected species currently inhabiting RASS 2.

Engineering Feasibility. The technologies proposed for implementation under Alternative 2-3D are standard engineering and scientific practices. Primary technical concerns include the ability to excavate in wetlands, the moisture content of the excavated materials, the load bearing strength of the soils being excavated (will they support construction equipment), sedimentation effects on areas not selected for active remediation, transporation and disposal of Class III materials, development of an adequate solidification/stabilization process, development of a monofill, and development of proposed action levels for the environmental monitoring program.

Several excavation techniques are available that can excavate the contaminated wetland materials. A combination of bulldozers, clamshells, frontend loaders, and dump trucks can be used for excavation. In order to minimize technical problems, excavation activities should be scheduled for the dry season. This may increase the fugitive dust problem; however, this can be controlled by sprinkling or other dust control measures. Excavation during the dry seasons will also minimize the potential problem of free liquids in the contaminated soils. Sedimentation effects on adjacent areas can be controlled by existing technology.

Transportation of contaminated materials to the monofill would be by truck, which is a proven technology. The loss of contaminated materials would be minimized through the use of liners and covers. In addition, the contaminants would be immobilized in the soil by the solidification/stabilization process.

Disposal of solidified/stabilized soils in a monofill located on NWS Concord may raise technical concerns over the long term durability of such materials. Because of these concerns and the results of the geological investigations conducted by Lutton et al (1987) any monofill constructed on NWS Concord should be designed to meet Class I engineering standards. Use of Class I

engineering standards, combined with the relatively limited mobility of metals, would provide long term security for disposal of the solidified/ stabilized materials. Note, however, that none of the available monofill sites on NWS Concord meet Class I siting requirements (Lutton et al 1987).

Solidification/stabilization of wastes containing high levels of heavy metals has been demonstrated; however, the process must be developed on a site specific basis. Implementation of a solidification/stabilization technology in California is complicated by the two phase test procedure (TTLC/STLC) and the use of a citric acid extraction that is substituted for the acetic acid extraction of the U.S. EPA's Extraction Procedure. Solidification/ stabilization does not remove the metals. Other than for the dilution effects caused by adding large amounts of binder, the TTLC is essentially unchanged. The citric acid extraction is generally believed to be more rigorous than the acetic acid extraction and the data base for successful solidification/ stabilization when using a citric acid extraction is limited. Discussions with State of California regulatory personnel (Tornatele 1988) indicated that some success has been demonstrated in reducing the STLC and that special waivers of the TTLC requirement can be obtained when solidification/ stabilization is implemented.

The proposed environmental monitoring techniques are standard engineering and scientific practices that can be executed without project delay. Care must be taken to ensure that the sample size for the biological monitoring is sufficient and organized in a way to allow for evaluation of statistical significance. Difficulties may be encountered in the development of proposed action levels; however, these difficulties are not expected to present a major obstacle to execution of this alternative.

<u>Costs</u>. The present worth cost of Alternative 2-3D is estimated to be $3,524,000.

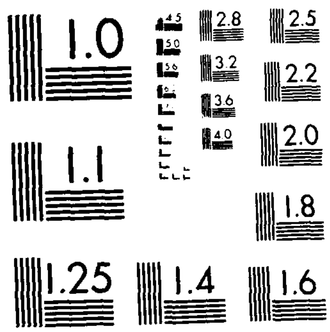
5.2.2.7 Alternative 2-3E: Excavation/Soil Washing/Disposal at Existing Landfills

Description. This alternative consists of excavation of the contaminated soils and removal of the contamination by chemical washing (Nash 1986). Excavated soils would be classified into Class I, II, or III waste. Class I and II wastes will be treated. The washed soils would be transported to an existing Class III land disposal facility. The soil washing would be accomplished by pumping an aqueous solution of acids, bases, surfactants, chelating agents, or any combination thereof, through a series of three upflow soil column reactors. The contaminated washing solutions would be treated for recycling of the washing agents. The resulting waste sludges would be treated and transported to an existing Class I disposal facility. Major components of this alternative include: large scale pilot study, excavation, soil washing, transportation of treated soils and sludges to existing disposal facilities of the appropriate class, disposal of the materials (cleaned soils and sludges from leaching solution recycling) in an appropriate class of landfill, and long term monitoring of the remediation area.

Environmental and Public Health Screening. This alternative provides for substantial remediation of ecological and health hazards associated with contaminated soils in RASS 2, including possible transport of contaminated materials to other important ecosystems such as those found in RASS 1 and Suisun Bay.

Excavation of contaminated materials presents the potential for adverse effects caused by exposure of construction personnel and the general public to the excavated materials during transport of the materials to existing disposal facilities. Impacts on the general public from the contaminated soils will be minimized because the contaminants would be removed by the soil washing process. An effluent stream of sludges containing high levels of heavy metal would be generated and would require transport to a Class I land disposal facility. The amount of sludge is estimated to be twenty percent of the volume of treated soil. Fugitive dust may be a problem; however, this can be minimized through proper planning and design.

AD-A199 116 FEASIBILITY STUDY OF CONTAMINATION REMEDIATION AT NAVAL 4/10
WEAPONS STATION C..(U) ARMY ENGINEER WATERWAYS
EXPERIMENT STATION VICKSBURG MS ENVIR..
UNCLASSIFIED M J CULLINANE ET AL. SEP 88 F/G 24/3 NL


1.0
2.8
2.5
3.2
2.2
3.6
4.0
2.0
1.1
1.8
1.25
1.4
1.6

The excavation of contaminated materials would also impact the important wetlands found in RASS 2 and would impact resident wildlife populations by death or displacement. Without proper planning and execution, sensitive areas in RASS 1 could also be impacted. Over time, however, the area of excavation will tend to silt in and the vegetation would recover. Uncertainty exists in the time required for silting and vegetation to recover. The probability that a pickleweed wetland will eventually establish naturally is low and the uncertainty is high. Consequently, natural recovery of suitable habitat for the protected species will more than likely have a low probability of success. In the short term, the habitat will be either a mudflat or standing water, depending on the final elevation and drainage patterns. Neither of these types of habitat would provide habitat for the protected species currently on-site (Lee et al. 1986). These short term impacts would be offset by the potential for long term recovery of the area once the contaminated materials have been removed.

Anticipated short term impacts can be minimized by proper planning of construction activities. For example, major construction activities can be timed to avoid the months when the highest level of reproductive activity occurs.

Trucks would be used for transporting the treated soils to existing land disposal facilities. Either truck or rail would be used for transport of the residual sludges to Class 1 disposal facilities. Disposal of sludges in existing landfills has the additional risk of exposing the general public to contaminated materials during transport of these materials to disposal facilities. Although the trucks would be lined and covered, passage of the trucks through towns and communities would raise community concerns. Additional truck traffic would cause noise pollution and a possible increase in accidents, which could cause loss of life, air pollution, and increased exposure to spilled contaminated materials. Since the soil washing process removes and concentrates contaminants, the potential exposure to contaminated material should be reduced.

Alternative 2-3E provides long term environmental protection at the expense of significant short term impacts. In the long term, natural regrowth of vegetation may offset any short term impacts. However, there is a low probability

that the habitat would be suitable for the protected species currently inhabiting RASS 2.

Engineering Feasibility. Except for the soil washing technology, the technologies proposed for implementation under Alternative 2-3E are standard engineering and scientific practices. The overriding technical concern associated with this alternative is development of a soil washing process. Other technical concerns include the ability to excavate in wetlands, the moisture content of the excavated materials, the load bearing strength of the soils being excavated (will they support construction equipment), sedimentation effects on areas not selected for active remediation, transportation and disposal of Class III materials, transportation and disposal of Class I materials, and development of proposed action levels for the environmental monitoring program.

Several excavation techniques are available that can be used to excavate the contaminated wetland materials. A combination of bulldozers, clamshells, frontend loaders, and dump trucks can be used for excavation. In order to minimize technical problems, excavation activities should be scheduled for the dry season. This may increase the fugitive dust problem; however, this can be controlled by sprinkling or other dust control measures. Excavation during the dry seasons will also minimize the potential problem of free liquids in the contaminated soils. Sedimentation effects on adjacent areas can be controlled by existing technology.

Although it is expected that the cleaned soils will be suitable for unrestricted use, for cost estimating purposes, it is assumed that the materials will be disposed of in a Class III landfill. Transportation of decontaminated materials to the monofill would be by truck, which is a proven technology. The loss of materials will be minimized through the use of liners and covers. Since it is expected that the decontaminated soils will be suitable for unrestricted use, materials loss would not be a critical technical issue. The sludge produced by the soil washing process would be transported to an existing Class I facility by truck or rail. Both truck and rail transportation of contaminated soils are proven technologies. The loss of contaminated materials will be minimized through the use of liners and covers.

Although demonstrated to some degree in the mining and ore processing industry, soil washing for removal of arsenic and heavy metals from contaminated soils has not been proven in a large scale remedial action. The process is developmental and would require additional laboratory and pilot scale study before implementation on a scale of the proposed remedial action for RASS 2. Personnel communications (Tetra Resources 1988, Environmental Field Services 1988, OH Materials 1987, USEPA 1987) indicates conflicting opinions on the technical feasibility of soil washing. If the soil washing process proves to be technically feasible, two waste streams are produced: the decontaminated soils and a sludge containing the heavy metals removed from the soil. It is assumed that the soil will be cleaned sufficiently for unrestricted use; however, the sludge containing the heavy metals will be a Class I and possibly a RCRA waste.

The proposed environmental monitoring techniques are standard engineering and scientific practices that can be executed without project delay. Care must be taken to ensure that the sample size for the biological monitoring is sufficient and organized in a way to allow for evaluation of statistical significance. Difficulties may be encountered in the development of proposed action levels; however, these difficulties are not expected to present a major obstacle to execution of this alternative.

Costs. The present worth cost of Alternative 2-3E is estimated to be $4,199,000.

5.2.2.8 Alternative 2-3F: Excavation/Soil Washing/Disposal at Monofill on NWS Concord

Description. This alternative consists of excavation of the contaminated soils and removal of the contamination by chemical washing (Nash and Traver 1986). Excavated soils will be classified into Class I, II, and III wastes. Class I and II wastes will be treated. The washed soils would be transported to a monofill on NWS Concord constructed to Class III standards. The soil washing would be accomplished by pumping an aqueous solution of acids, bases, surfactants, chelating agents, or any combination thereof, through a series of three upflow soil column reactors. The contaminated washing solutions would

be treated for recycling of the washing agents. The resulting waste sludges would be treated and transported to an existing Class I disposal facility. Major components of this alternative include: large scale pilot study, excavation, soil washing, transportation of treated soils to Class III monofill located on NWS Concord, transport of sludges to an existing Class I disposal facility, disposal of the washed soils and resulting sludges in the appropriate landfill, long term monitoring of the monofill, and long term monitoring of the remediation area.

Environmental and Public Health Screening. This alternative provides for substantial remediation of ecological and health hazards associated with contaminated soils in RASS 2, including possible transport of contaminated materials to other important ecosystems such as those found in RASS 2 and Suisun Bay.

Excavation of contaminated materials presents the potential for adverse effects caused by exposure of construction personnel and persons located on NWS Concord to the excavated materials during transport of the materials to the monofill. Impacts on the general public from the contaminated soils will be minimized because the contaminants would be removed by the soil washing process and the cleaned soil would be disposed of on NWS Concord. An effluent stream of contaminated sludges would be generated that would require transport to a Class I land disposal facility. The quantity of sludges is estimated to be twenty percent of the volume of treated soils. Fugitive dust may be a problem; however, this can be minimized through proper planning and design.

The excavation of contaminated materials would impact the important wetlands found on RASS 2 and would also impact resident wildlife populations by death or displacement. Without proper planning and execution of this alternative, sensitive areas in RASS 1 could also be impacted. Over time, however, the area of excavation would tend to silt in and the vegetation would recover. Uncertainty exists in the time required for silting and vegetation to recover. The probability that a pickleweed wetland will eventually establish naturally is low and the uncertainty is high. Consequently, natural recovery of suitable habitat for the protected species will more than likely have a low probability of success. In the short term, the habitat will be either a mudflat or standing water, depending on the final elevation and drainage patterns.

Neither of these types of habitat would provide habitat for the protected species currently on-site (Lee et al. 1986). These short term impacts would be offset by the potential for long term recovery of the area once the contaminated materials have been removed.

Anticipated short term impacts can be minimized by proper planning of construction activities. Major construction activities can be timed to avoid the months when the highest level of reproductive activity occurs.

Trucks would be used for transporting the treated soils to the monofill. The disposal of the decontaminated soils on NWS Concord reduces the risk of exposing the general public to contaminated materials during transport of these materials to the disposal facilities. Sludges generated by the soil washing process would be transported by truck or rail to existing Class I disposal facilities. Although the trucks or rail cars would be lined and covered, passage of the trucks through NWS Concord and surrounding towns and communities would raise community concerns. Additional truck traffic would cause noise pollution and a possible increase in accidents, which could cause loss of life, air pollution, and increased exposure to spilled contaminated materials. Since the decontaminated soils would be disposed of on NWS Concord, the transportation of Class I materials would be minimized.

Alternative 2-3F provides long term environmental protection at the expense of significant short term impacts. In the long term, natural regrowth of vegetation may offset any short term impacts. However, there is a low probability that the habitat would be suitable for the protected species currently inhabiting RASS 2.

Engineering Feasibility. Except for the soil washing technology, the technologies proposed for implementation under Alternative 2-3F are standard engineering and scientific practices. The overriding technical concern associated with this alternative is development of a soil washing process. Other technical concerns include the ability to excavate in wetlands, the moisture content of the excavated materials, the load bearing strength of the soils being excavated (will they support construction equipment), sedimentation effects on areas not selected for active remediation, transportation and

disposal of Class III materials, transportation and disposal of Class I materials, and development of proposed action levels for the environmental monitoring program.

Several excavation techniques are available that can be used to excavate the contaminated wetland materials. A combination of bulldozers, clamshells, frontend loaders, and dump trucks can be used for excavation. In order to minimize technical problems, excavation activities should be scheduled for the dry season. This may increase the fugitive dust problem; however, this can be controlled by sprinkling or other dust control measures. Excavation during the dry seasons will also minimize the potential problem of free liquids in the contaminated soils.

Although it is expected that the cleaned soils will be suitable for unrestricted use, for cost estimating purposes, it is assumed that the materials will be disposed of in a Class III landfill on NWS Concord. Transportation of decontaminated materials to the monofill would be by truck, which is a proven technology. The loss of materials will be minimized through the use of liners and covers. Since it is expected that the decontaminated soils will be suitable for unrestricted use, materials loss would not be a critical technical issue. The sludge produced by the soil washing process would be transported to an existing Class I facility by truck or rail. Both truck and rail transportation of contaminated soils are proven technologies. The loss of contaminated materials will be minimized through the use of liners and covers.

Although demonstrated to some degree in the mining and ore processing industry, soil washing for removal of arsenic and heavy metals from contaminated soils has not been proven in a large scale remedial action. The process is developmental and would require additional laboratory and pilot scale study before implementation on a scale of the proposed remedial action for RASS 1. Personnel communications (Tetra Resources 1988, Environmental Field Services 1988, OH Materials 1987, USEPA 1987) indicate conflicting opinions on the technical feasibility of soil washing. If the soil washing process proves to be technically feasible, two waste streams are produced: the decontaminated soils and a sludge containing the heavy metals removed from the soil. It is assumed that the soil will be cleaned sufficiently for unrestricted use;

however, the sludge containing the heavy metals will be a Class I and possibly a RCRA waste.

The proposed environmental monitoring techniques are standard engineering and scientific practices that can be executed without project delay. Care must be taken to ensure that the sample size for the biological monitoring is sufficient and organized in a way to allow for evaluation of statistical significance. Difficulties may be encountered in the development of proposed action levels; however, these difficulties are not expected to present a major obstacle to execution of this alternative.

Costs. The present worth cost of Alternative 2-3F is estimated to be $5,116,000.

5.2.2.9 Alternative 2-4A: Capping with Soil Cover

Description. This alternative examines the use of a soil/vegetative cover to reduce the possibility of erosion and direct contact with the contaminated soil materials. The contaminated soil materials located in RASS 2 would not be removed. The primary components of this alternative include: site preparation, placement of a soil cover, grading, revegetation of the cover, and long term monitoring of the remediation area.

Environmental and Public Health Screening. This alternative will substantially eliminate the potential for exposure of biota or humans through direct contact with the highly contaminated surficial soils, and it would prevent resuspension and redistribution of the contaminated soils intc adjacent uncontaminated or slightly contaminated areas. Furthermore, migration of contaminants into RASS 1 and Suisun Bay from RASS 2 would be prevented. Prevention of biota contact with the contaminated soils would prevent food chain transfer of the contaminants to humans and reduce or eliminate potential health effects of concern.

Although the implementation of the soil cap would prevent further migration of contaminants into adjacent areas, there would be long term adverse impacts associated with raising the natural elevation of RASS 2. The top soil cover

would raise the ground elevation a minimum of 4 ft. Depending on the cleanup criteria selected, significant portions of important wetlands found in RASS 2 would be converted into upland and a transition zone. Regulatory issues would be raised with any proposal to fill and destroy wetlands with a resultant loss of habitat and harm to endangered species.

Engineering Feasibility. The technologies proposed for implementation under Alternative 2-4A are standard engineering and scientific practices. Technical concerns include the ability to construct a soil cap on the wetland, the load bearing strength of the soils on which the cap would be constructed (will they support the cap without excessive long term maintenance), sedimentation effects on areas not selected for active remediation, and development of proposed action levels for the environmental monitoring program.

Construction of the soil cap will be similar to a filling operation, which is a proven technology. Adequate geotechnical design procedures are available to ensure that the cap is durable and performs its intended purpose. Sedimentation effects on adjacent areas can be controlled by existing technology.

The proposed environmental monitoring techniques are standard engineering and scientific practices that can be executed without project delay. Care must be taken to ensure that the sample size for the biological monitoring is sufficient and organized in a way to allow for evaluation of statistical significance. Difficulties may be encountered in the development of proposed action levels; however, these difficulties are not expected to present a major obstacle to execution of this alternative.

Costs. The present worth cost of Alternative 2-4A is estimated to be $1,391,000.

5.2.2.10 Alternative 2-4B: Source Isolation/RCRA Cap

Description. This alternative examines the use of a multilayered cover (RCRA cap) to reduce the possibility of erosion and direct contact with the contaminated soil material. The contaminated soil materials located in RASS 2 would not be removed. The primary components of this alternative include:

site preparation, placement of a cover meeting RCRA requirements, grading, and revegetation of the cover. At a minimum, the RCRA cap would include a 2 ft thick low permeability (10^{-7}) soil layer, a 12 in. drainage layer, a 20 mil synthetic membrane with bedding, and a 2 ft layer of topsoil. Finally, the cover would be graded and revegetated. A cross-section of the proposed RCRA cap is illustrated in Plate 5.3.

Environmental and Public Health Screening. This alternative will substantially eliminate the potential for exposure of biota or humans through direct contact with the highly contaminated surficial soils, and it would prevent resuspension and redistribution of the contaminated soils into adjacent uncontaminated areas. Furthermore, migration of contaminants into Suisun Bay would be prevented. Prevention of biota contact with the contaminated soils would prevent food chain transfer of the contaminants to humans and reduce or eliminate potential health effects of concern. Implementation of the RCRA cap alternative would also prevent the transport of contamination into the underlying groundwater.

Although the implementation of the RCRA cap would prevent further migration of contaminants into adjacent areas and ground water, there would be long term adverse impacts associated with raising the natural elevation of RASS 2. The RCRA cover would raise the ground elevation a minimum of 6 ft. Depending on the cleanup criteria selected, significant portions of important wetlands found in RASS 2 would be converted into upland and a transition zone. Regulatory issues would be raised with any proposal to fill and destroy wetlands with a resultant loss of habitat and harm to endangered species.

Engineering Feasibility. The technologies proposed for implementation under Alternative 2-4A are standard engineering and scientific practices. Technical concerns include the ability to construct a RCRA cap on the wetland, the load bearing strength of the soils on which the cap would be constructed (will they support the cap without excessive long term maintenance), sedimentation effects on areas not selected for active remediation, and development of proposed action levels for the environmental monitoring program.

Construction of the RCRA cap will be similar to a filling operation, which is a proven technology. Adequate geotechnical design procedures are available to ensure that the cap is durable and performs its intended purpose. Sedimentation effects on adjacent areas can be controlled by existing technology.

The proposed environmental monitoring techniques are standard engineering and scientific practices that can be executed without project delay. Care must be taken to ensure that the sample size for the biological monitoring is sufficient and organized in a way to allow for evaluation of statistical significance. Difficulties may be encountered in the development of proposed action levels; however, these difficulties are not expected to present a major obstacle to execution of this alternative.

Costs. The present worth cost of Alternative 2-4B is estimated to be $1,950,000.

5.2.2.11 Alternative 2-5A: On-Site Restoration

Description. Whereas site remediation emphasizes the cleanup of a release of contaminated materials, site restoration emphasizes the return of environmental conditions to a pre-existing condition or enhancement of the current environmental condition. In most cases, it is expected that restoration activities would be much more costly than implementation of remedial action alternatives. Alternative 2-5A incorporates the concept of full restoration of active remediation areas of RASS 2. Implementation of Alternative 2-5A assumes implementation of one the the excavation alternatives (Alternative 2-3A through 2-3F) with an add on restoration element that includes both flora and fauna restoration. A detailed restoration plan would be developed as part of this alternative. The restoration plan would give particular attention to the acquisition and planting of plant species normally found in the wetland areas of RASS 2.

Environmental and Public Health Screening. In the long term, the goal of restoration is to minimize the environmental effects of contamination and remedial action. This alternative provides substantial remediation of ecological and health hazards associated with contaminated soils in RASS 2,

including possible transport of contaminated materials to other important ecosystems such as RASS 1 and Suisun Bay. In addition, contaminated areas in RASS 2 would be restored to productive wetland in the shortest practicable time period.

Excavation of the contaminated soils presents the potential for adverse effects caused by exposure of construction personnel and persons located off-site to the excavated materials during transport of the materials to disposal facilities. The excavation of contaminated materials would impact the important wetland habitat found in RASS 2 and would also impact resident wildlife populations by death or displacement. These short term impacts would be offset by the potential for long term recovery of the area once the contaminated materials have been removed.

Anticipated short term impacts can be minimized by proper planning of construction activities. For example, prior to excavation, the endangered salt marsh harvest mouse could be trapped and removed from RASS 2 to a suitable wetland prior to the initiation of construction activities.

Trucks or rail cars would be used for transporting contaminated or treated soils to storage, treatment, and disposal facilities. If existing landfills were selected as the final disposal site, there is an additional risk of exposure of the general public to contaminated materials during transport of these materials to the disposal facilities. Although the trucks or rail cars would be lined and covered, passage of the trucks through towns and communities would raise community concerns. Additional truck traffic would cause noise pollution and a possible increase in accidents, which could cause loss of life, air pollution, and increased exposure to spilled contaminated materials. Implementation of a disposal alternative that includes construction of a landfill on NWS Concord would limit these impacts to NWS Concord and public transportation corridors traversing NWS Concord.

Alternative 2-5A provides long term environmental protection at the expense of rather severe short term impacts. These short term impacts are minimized by the active restoration of the excavated areas. Since contamination is removed from the wetland environment and the wetland is returned to pre-existing

conditions in the shortest possible time frame, on-site restoration provides the greatest level of environmental protection of any alternative considered.

Engineering Feasibility. Except for the soil washing technology, the technologies proposed for implementation under Alternative 2-5A are standard engineering and scientific practices that can be executed without project delay. Excavation of contaminated materials from wetlands may present problems in execution of this alternative. Primary technical concerns include the ability to excavate in wetlands, the moisture content of the excavated materials, the load bearing strength of the soils being excavated (will they support construction equipment), sedimentation effects on areas not selected for active remediation, transportation and disposal of contaminated or treated materials, and wetland restoration. Difficulties may also be encountered in the development of proposed action levels.

Several excavation techniques are available that can be used to excavate the contaminated wetland materials. A combination of bulldozers, clamshells, frontend loaders, and dump trucks can be used for excavation. In order to minimize technical problems, excavation activities should be scheduled for the dry season. This may increase the fugitive dust problem; however, this can be controlled by sprinkling or other dust control measures. Excavation during the dry seasons will also minimize the potential problem of free liquids in the contaminated soils.

Transportation of contaminated or treated materials to existing landfills or to a monofill located on NWS Concord would be by truck or rail. Both truck and rail transportation of contaminated soils are proven technologies. The loss of contaminated materials will be minimized through the use of liners and covers.

Disposal of contaminated soils in a Class I landfill is a proven technology. Although there is usually technical concerns over the possibility that the landfill will leak, these concerns are usually addressed through the implementation of siting controls and engineered features such as liners and leak detection systems. There are several Class I landfills in operation that can accept the types of materials that will be excavated from RASS 1. No

available monofill sites on NWS Concord meet siting requirements for a Class I facility. Concerns over the long term durability of solidified/stabilized materials require the disposal of such materials in a facility engineered to Class I standards.

Although some uncertainty exists in wetland restoration, several factors would act to increase the probability of success of this alternative. Recommendations for specific objectives and plans for monitoring would be followed. Regional goals, i.e., interest in the salt marsh harvest mouse and two species of rail, are clear, leading to the objective of restoration of a pickleweed marsh and associated transition zone vegetation. The detailed restoration plan would be written in concert with local experts in wetland restoration and rely heavily on guidelines for local conditions such as those found in Josselyn and Buchholz (1982). Because long term monitoring is an integral part of the restoration plan, adequate provisions would be developed to monitor execution and progress of the restoration and to allow corrective action as necessary.

The proposed environmental monitoring techniques are standard engineering and scientific practices that can be executed without project delay. Care must be taken to ensure that the sample size for the biological monitoring is sufficient and organized in a way to allow for evaluation of statistical significance. Difficulties may be encountered in the development of proposed action levels; however, these difficulties are not expected to present a major obstacle to execution of this alternative.

Costs. The present worth cost of Alternative 2-5A is estimated to be $3,216,000.

5.2.2.12 Alternative 2-5B: Off-Site Restoration

Description. This alternative incorporates the remediation of contamination in RASS 2 using one of the capping alternatives (Alternatives 2-4A or 2-4B) with off-site mitigation of the loss of wetland areas. An area of equivalent acreage would be obtained to offset any loss of wetlands due to capping.

Environmental and Public Health Screening. This alternative will substantially eliminate the potential for exposure of biota or humans through direct contact with the highly contaminated surficial soils, and it would prevent resuspension and redistribution of the contaminated soils into adjacent uncontaminated or slightly contaminated areas. Furthermore, migration of contaminants into RASS 1 and Suisun Bay from RASS 2 would be prevented. Prevention of biota contact with the contaminated soils would prevent food chain transfer of the contaminants to humans and reduce or eliminate potential health effects of concern.

Although the implementation of the top soil cap would prevent further migration of contaminants into adjacent areas, there would be long term adverse impacts associated with raising the natural elevation of RASS 2. The top soil cover would raise the ground elevation a minimum of 4 ft. Depending on the cleanup criteria selected, significant portions of important wetlands found in RASS 2 would be converted into upland and a transition zone. Regulatory issues would be raised with any proposal to fill and destroy wetlands with a resultant loss of habitat and harm to endangered species. The loss of wetlands will be mitigated by the acquisition of off-site wetlands or the acquisition of lands that will be converted into wetlands.

Engineering Feasibility. The technologies proposed for implementation under Alternative 2-5B are standard engineering and scientific practices that can be executed without project delay. Technical concerns include the ability to construct a soil or RCRA cap on the wetland, the load bearing strength of the soils on which the cap would be constructed (will they support the cap without excessive long term maintenance), sedimentation effects on areas not selected for active remediation, restoration of wetlands, and development of proposed action levels for the environmental monitoring program.

Construction of the soil or RCRA cap will be similar to a filling operation, which is a proven technology. Adequate geotechnical design procedures are available to ensure that the cap is durable and performs its intended purpose. Sedimentation effects on adjacent areas can be controlled by existing technology.

Although uncertainty exists in conversion of agricultural land to wetland, several factors would act to increase the probability of success of this alternative. Recommendations for specific objectives and plans for monitoring would be followed. Regional goals, i.e., interest in the salt marsh harvest mouse and two species of rail, are clear, leading to the objective of restoration of a pickleweed marsh and associated transition zone vegetation. The detailed restoration plan would be written in concert with local experts in wetland restoration and rely heavily on guidelines for local conditions such as those found in Josselyn and Buchholz (1982). Because long term monitoring is an integral part of the restoration plan, adequate provisions would be developed to monitor execution and progress of the restoration and to allow corrective action as necessary.

The proposed environmental monitoring techniques are standard engineering and scientific practices that can be executed without project delay. Care must be taken to ensure that the sample size for the biological monitoring is sufficient and organized in a way to allow for evaluation of statistical significance. Difficulties may be encountered in the development of proposed action levels; however, these difficulties are not expected to present a major obstacle to execution of this alternative.

Costs. The present worth cost of Alternative 2-5B is estimated to be $1,583,000.

5.2.2.13 Alternative 2-6A: In Situ Stabilization

Description. The in situ stabilization alternative consists of injecting the in place contaminated soils with chemical reagents to immobilize the contaminants in the soil. The process is similar to the excavation/immobilization alternatives (Alternative 2-3C and 2-3D), except that the binder chemicals are mixed with the inplace soils and the contaminated soils are not excavated. The major components of this alternative include: development of a solidification/stabilization process, stripping of vegetation, application of the solidification/stabilization binder, revegetation, periodic reapplication of the binder, and long term environmental monitoring of the remediation area.

Environmental and Public Health Screening. This alternative provides limited remediation of the ecological and health hazards associated with the contaminated soils in RASS 2. The primary mechanism of the in situ stabilization process is to reduce the solubility of the metals and thereby reduce their bioavailability. The in situ immobilization process does not remove the metals from the soils. Metals would be available to migrate with any soil or sediment that is physically moved by hydrologic processes. Because of the dynamic hydrologic environment of RASS 2, it is probable that continued migration of contaminants would occur.

Since the metals would remain in the soil, the potential for direct contact would remain. In situ stabilization would reduce the availability of the contaminants.

Because physical migration would be likely, mere chemical stabilization of the soils would not be totally effective in reducing contaminant migration. The soils could be physically stabilized by adding sufficient binder materials; however, addition of binder materials in the quantities required for physical stabilization would most probably have environmental consequences similar to the capping alternatives, i.e, the nature of the habitat would be substantially changed and would probably not support the species currently living on the site.

In situ stabilization requires periodic reapplication of binder materials, there would be a continued presence in RASS 2. It is estimated that reapplication of binder materials would be necessary every five to ten years. Reapplication would involve similar activities to the initial application. Because of the maintenance requirements, adverse impacts of the in situ stabilization alternative would be long term and continuing. This alternative would have severe short term impacts as well as major long term adverse impacts on vegetation and wildlife that try to colonize the RASS.

Engineering Feasibility. Primary technical concerns include the ability to apply binder materials in wetlands, the load bearing strength of the soils (will they support construction equipment), sedimentation effects on areas not selected for active remediation, development of a solidification/stabilization

process that can be applied in situ in the wetlands. Difficulties may also be encountered in the development of proposed action levels.

The primary technology, in situ stabilization, proposed for implementation in this alternative has not been demonstrated on a large scale, nor have they been applied in a wetland environment. Although the technology is similar to solidification/stabilization technology used in the excavation/immobilization alternatives, the excavation alternatives have the advantage that the materials are removed from an active hydrologic environment and the solidification/stabilization processing is accomplished in a controlled environment. Of particular technical concern to this alternative is the long term durability of the treated soils in an active hydrologic environment. Since the in situ stabilization process is oriented towards the chemical immobilization of contaminants, it is likely that physical mobilization will continue.

Solidification/stabilization of wastes, containing high levels of heavy metals has been demonstrated; however, the process must be developed on a site specific basis. In situ stabilization in a wetland environment has not been demonstrated. Implementation of a solidification/stabilization technology in California is complicated by the two phase test procedure (TTLC/STLC) and the use of a citric acid extraction that is substituted for the acetic acid extraction of the U.S. EPA's Extraction Procedure. Solidification/stabilization does not remove the metals, and other than the dilution effects caused by adding large amounts of binder, the TTLC is essentially unchanged. The citric acid extraction is generally believed to be more rigorous than the acetic acid extraction and the data base for successful solidification/stabilization when using a citric acid extraction is limited. Discussions with State of California regulatory personnel (Tornatele 1988) indicated that some success has been demonstrated in reducing the STLC and that special waivers of the TTLC requirement may be made when solidification/stabilization is implemented. These potential technical problems are compounded in this alternative because the alternative leaves the treated materials in an active environment rather than placing them in a controlled landfill environment. Sedimentation effects during the remediation process on adjacent areas can be controlled by existing technology.

The proposed environmental monitoring techniques are standard engineering and scientific practices that can be executed without project delay. Care must be taken to ensure that the sample size for the biological monitoring is sufficient and organized in a way for evaluation of statistical significance. Difficulties may be encountered in the development of proposed action levels; however, these difficulties are not expected to present a major obstacle to execution of this alternative.

Overall, because of site specific reasons, the engineering feasibility of this alternative is low.

Costs. The present worth costs of Alternative 2-6A is estimated to be $2,599,000.

5.2.2.14 Alternative 2-6B: Soil Flushing

Description. The soil flushing alternative consists of injecting a soil washing solution to dislodge, solubilize, or otherwise remove the contaminants from the soils. Chemically, the soil flushing alternative is similar to the soil washing alternatives (Alternative 2-3E and 2-3F). Possible flushing agents include water, acids, bases, chelating agents, and/or surfactants. The major components of this alternative include: development of a soil washing process that is effective for the contaminants found on RASS 2, construction of a flushing agent application and recovery system, application and recovery of the soil flushing agents, treatment of the recovered soil flushing agents, disposal of residual sludges and flushing agents, and environmental monitoring of the remediation area.

Environmental and Public Health Screening. This alternative provides substantial remediation of ecological and health hazards associated with the contaminated soils in RASS 2, including possible transport of contaminated materials to other important ecosystems such as Suisun Bay.

The soil flushing process produces an effluent stream of sludges that will be classified as Class I and possibly RCRA wastes. The amount of sludge would be similar to that produced in the soil washing alternatives and is estimated to

be approximately 20 percent of the treated soils. The residual sludges would be transported to an existing Class I landfill for disposal. Lined and covered trucks or rail cars would be the primary means of transport. Transport of these materials has the additional risk of exposure of the general public to contaminated materials. Passage of the trucks and rail cars through populated areas may raise community concerns. Additional traffic would cause noise pollution, and a possible increase in accidents, which could cause loss of life, air pollution, and increased exposure to contaminated materials.

The construction of soil flushing reagent application and recovery system would cause severe short term disruption of the habitat in RASS 2. Anticipated short term impacts could be minimized by proper planning of construction activities; however, since the application and recovery of the soil flushing reagents may take several seasons, short term impacts may occur for a substantial period of time.

In addition to the disruption caused by construction activities, some soil flushing reagents may be toxic or hazardous. Since 100 percent recovery of the soil flushing reagents is unlikely, soil flushing may have a detrimental impact on the plant and wildlife in RASS 2.

Alternative 2-6B provides long term environmental protection at the expense of substantial short term impacts.

Engineering Feasibility. Soil flushing technology is not considered to be a standard engineering or scientific technology for remediation of contaminated sites. The overriding technical concern associated with this alternative is development of a soil flushing process. Other technical concerns include the load bearing strength of the soils, (will they support construction equipment), the permeability of the soils (can the flushing agents be recovered), sedimentation effects on areas not selected for active remediation, transportation and disposal of Class I materials, and development of proposed action levels for the environmental monitoring program.

The chemistry of soil flushing is similar to that of soil washing (Alternatives 2-3E and 2-3F). The process is developmental and would require

additional laboratory and pilot scale study before implementation on a scale of the proposed remedial action for RASS 2. If the soil flushing process proves to be technically feasible, a sludge containing the heavy metals removed from the soil would require disposal. It is assumed that the soil will be cleaned sufficiently for unrestricted use; however, the sludge containing the heavy metals will be a Class I and possibly a RCRA waste.

Construction of a flushing agent application and recovery system in the wetland environment will be technically difficult. Although construction could be scheduled for the dry season, the low permeability of the soils would necessitate construction of recovery wells or underdrains at a close interval, thus increasing the cost and making complete recovery of the flushing agents difficult. This may be particularly important since some of the reagents used for soil flushing are hazardous substances.

The proposed environmental monitoring techniques are standard engineering and scientific practices that can be executed without project delay. Care must be taken to ensure that the sample size for the biological monitoring is sufficient and organized in a way to allow for evaluation of statistical significance. Difficulties may be encountered in the development of proposed action levels; however, difficulties are not expected to present a major obstacle to execution of this alternative.

The engineering feasibility of the soil flushing alternative is considered to be low.

Costs. The present worth cost of Alternative 2-6B is estimated to be $3,738,000.

5.2.3 Alternatives for Remedial Action Subsite 3. Twelve potential remedial action alternatives were initially developed for RASS 3. These included the following.

a. Alternative 3-1: No Action
b. Alternative 3-2: Environmental Monitoring
c. Alternative 3-3A: Excavation/Disposal at Existing landfills
d. Alternative 3-3B: Excavation/Disposal at Monofill on NWS Concord

e. Alternative 3-3C: Excavation/Immobilization/Disposal at Existing Landfills

f. Alternative 3-3D: Excavation/Immobilization/Disposal at Monofill on NWS Concord

g. Alternative 3-3E: Excavation/Soil Washing/Disposal at Existing Landfills

h. Alternative 3-3F: Excavation/Soil Washing/Disposal at Monofill on NWS Concord

i. Alternative 3-4A: Source Isolation/Soil Cap

j. Alternative 3-4B: Source Isolation/RCRA Cap

k. Alternative 3-6A: In Situ Stabilization

l. Alternative 3-6B: Soil Flushing

5.2.3.1 Alternative 3-1: No Action

Description. The no action alternative involves no additional positive remedial action activities. Soils containing high levels of heavy metals would be left in place. No additional monitoring would be implemented. Warning signs and public education programs would be used to inform the public about potential hazards. Property records would be annotated to document the location of known and suspected contamination.

Environmental and Public Health Screening. The no action alternative would not measurably change the current likelihood of exposure of aquatic and wetland biota to very high concentrations of heavy metals in the surface soils and sediments. The possibility of direct human contact with the contaminated sediments would be only minimally reduced with signs and an education program.

Under the no action alternative, contaminants would continue to migrate from the contaminated area through the pathways described in Section 3. The areal extent of contamination would increase and spread from RASS 3 into wetland areas in RASS 2 and RASS 1 and eventually into Suisun Bay. While the concentrations of heavy metals might be attenuated by natural dilution effects, a wider range of aquatic and wetland biota will be exposed to the contaminants. In addition, the potential for large discharges of sediment sorbed contaminants will continue to exist whenever a storm occurs at NWS Concord. Such

events will inevitably expose downstream aquatic and wetland biota to higher concentrations of contamination.

On site sampling and subsequent analyses have confirmed that significant quantities of hazardous substances remain in the surface soils (0-12 in.) of RASS 3. In addition, a smaller area of contamination at depths to 24 in. was located. These substances are subjected to environmental stresses from the horizontal flow of surface water over and through the hazardous substances and, to a lesser extent, vertical infiltration of water through the contaminated soils and into the ground water. It is anticipated that migration of contaminants from RASS 2 through the surface water media will continue in both the near and long term.

The potential environmental effects of the no action alternative are described in detail by Lee et al. (1986).

Engineering Feasibility. The technologies proposed for implementation under the No Action alternative are standard engineering practices that can be executed without undue delay.

Costs. The present worth cost of the No Action alternative is estimated to be $155,000.

5.2.3.2 Alternative 3-2: Environmental Monitoring

Description. The environmental monitoring alternative features the no action alternative, i.e., no additional active remediation, augmented by implementation of continued environmental monitoring. Contaminated materials would be left in-place. A two phase environmental monitoring program would be implemented to periodically evaluate the environmental status of RASS 3 and those adjacent and downstream areas onto which contaminants are likely to migrate. At a minimum, the increased monitoring program would include surface water sampling, soil and sediment sampling, bioassays, and wildlife and habitat evaluations.

Phase 1 monitoring includes the collection and analysis of soil, surface water, and ground water samples. In addition, wildlife and vegetation would be observed and evaluated. Phase 1 sampling would be conducted annually for the first five years and every five years thereafter.

Phase 2 of the sampling program is oriented towards the evaluation of contaminant impacts on the biota of RASS 3 and adjacent and downstream areas. Phase 2 monitoring includes clam bioaccumulation studies, plant bioaccumulation studies, and qualitative monitoring of wetland areas. Phase 2 monitoring would be conducted every two years for the first five years and every five years thereafter.

Monitoring studies would be summarized in an annual report describing the results of the various sampling programs. The report would also contain an assessment of any physical changes in RASS 3 or adjacent areas, i.e., natural improvement or degradation of habitats, man-made alterations, etc. The report would also make recommendations for implementation of any required remedial actions.

Environmental and Public Health Screening. The environmental monitoring alternative would not measurably change the current likelihood of exposure of aquatic and wetland biota to very high concentrations of heavy metals. The possibility of direct human contact with the contaminated soils would be minimally reduced by posting of contaminated areas and a public education program.

The monitoring program would allow continued migration of heavy metals from the areas of high concentrations and the areal extent of the contamination would continue to increase. These contaminants could be released into RASS 1 and RASS 2. There would be some attenuation of the high levels of contamination because of dilution effects. The potential environmental effects are essentially the same as the no action alternative and are described in Lee et al. (1986). The threat of contamination of plants and wildlife including endangered species in RASS 1 and RASS 2 would continue and the potential for exposure would increase as the areal extent of contamination increases.

The monitoring alternative provides only limited positive environmental protection benefits above those provided by the no action alternative. Although the environmental monitoring alternative would not eliminate or reduce contamination of soils, surface waters, or sediments by continued migration of contaminants from current high level areas, increased monitoring would provide documentation of contaminant migration and its environmental impact. Wildlife studies would document species use of RASS 3, the contamination levels of collected species, and problems caused by continuous exposure to the hazardous substances. The environmental monitoring program would also provide an early warning of changes in conditions that may increase the potential for substantial environmental damage by continued contaminant release or an unexpected increase in the rate of release.

Engineering Feasibility. The technologies proposed for implementation under this alternative are standard engineering and scientific practices that can be executed without project delay. Care must be taken to ensure that the sample size for the biological monitoring is sufficient and organized in a way to allow for evaluation of statistical significance. Difficulties may be encountered in the development of proposed action levels; however, these difficulties are not expected to present a major obstacle to execution of this alternative.

Costs. The present worth cost of Alternative 3-2 is estimated to be $1,479,000.

5.2.3.3 Alternative 3-3A: Excavation/Disposal at Existing Landfills

Description. The excavation and disposal in existing landfills alternative consists of excavating contaminated materials followed by land disposal at a licensed off-site land disposal facility. The excavated materials will be classified into the appropriate categories (Class I, Class II, and Class III) for disposal in the appropriate level landfill. The major components of this alternative include: excavation of contaminated materials, classification of the contaminated materials, transportation of the contaminated materials to the appropriate existing disposal facility, disposal, and monitoring of the remediation area. The primary means of transportation assumed for planning

purposes is in lined and covered dump trucks with a capacity of approximately 18 cubic yards or covered rail cars with a capacity of 64 cubic yards. A survey of disposal facilities is presented in Table 5.1. These facilities have indicated that they are licensed to dispose of the types of waste materials that will be generated by the remediation activities anticipated in RASS 3.

Environmental and Public Health Screening. This alternative provides substantial remediation of ecological and health hazards associated with contaminated soils in RASS 3, including possible transport of contaminated materials to other important ecosystems such as RASS 1, RASS 2, and Suisun Bay.

Excavation presents the potential for adverse effects caused by exposure of construction personnel and persons located off-site to the excavated materials during transport of the materials to existing disposal facilities. The excavation of contaminated materials would impact freshwater wetlands found in RASS 3 and would impact resident wildlife populations by death or displacement. Excavation would have similar impacts to the normal drainage maintenance activities. RASS 1 and RASS 2 may also be impacted by activities in RASS 3. Over time, however, the area of excavation in RASS 3 will tend to silt in and the vegetation would recover. These short term impacts would be offset by the potential for long term recovery of the area once the contaminated materials have been removed. Anticipated short term impacts can be minimized by proper planning of construction activities.

Trucks or rail cars would be used for transporting contaminated soils to land disposal facilities. Therefore, disposal of contaminated materials in existing landfills has the additional risk of exposing the general public to contaminated materials during transport of these materials to disposal facilities. Trucks or rail cars would be lined and covered; however, passage of trucks through towns and communities would raise community concerns. Additional truck traffic would cause noise pollution and a possible increase in accidents, which could cause loss of life, air pollution, and increased exposure to spilled contaminated materials.

Alternative 3-3A provides long term environmental protection at the expense of significant short term impacts. In the long term, natural regrowth of

vegetation would substantially eliminate any short term impacts. Rapid recovery of RASS 3 following drainage maintenance activities has been observed.

Engineering Feasibility. The technologies proposed for implementation under Alternative 3-3A are standard engineering and scientific practices that can be executed without project delay. Excavation of contaminated materials from wetlands may present problems in execution of this alternative. Primary technical concerns include the ability to excavate in wetlands, the moisture content of the excavated materials, the load bearing strength of the soils being excavated (will they support construction equipment), sedimentation effects on areas not selected for active remediation, and transportation and disposal of Class I materials. Difficulties may also be encountered in the development of proposed action levels.

Several excavation techniques are available that can be used to excavate the contaminated wetland materials. A combination of bulldozers, clamshells, frontend loaders, and dump trucks can be used for excavation. In order to minimize technical problems associated with excavation, these activities should be scheduled for the dry season. This may increase the fugitive dust problem; however, this can be controlled by sprinkling or other dust control measures. Excavation during the dry seasons will also minimize the potential problem of free liquids in the contaminated soils. Sedimentation effects on adjacent areas can be controlled by existing technology such as silt barriers or silt screens.

Transporation of contaminated materials to existing landfills would be by truck or rail. Both truck and rail transportation of contaminated soils are proven technologies. The loss of contaminated materials will be minimized through the use of liners and covers.

Disposal of contaminated soils in a Class I landfill is a proven technology. Although there are usually technical concerns over the possibility that the landfill will leak, these concerns are usually addressed through the implementation of siting controls and engineered features such as liners and leak

detection systems. There are several Class I landfills in operation that can accept the types of material that will be excavated from RASS 1.

The proposed environmental monitoring techniques are standard engineering and scientific practices that can be executed without project delay. Care must be taken to ensure that the sample size for the biological monitoring is sufficient and organized in a way to allow for evaluation of statistical significance. Difficulties may be encountered in the development of proposed action levels; however, these difficulties are not expected to present a major obstacle to execution of this alternative.

Costs. The present worth cost of Alternative 3-3A is estimated to be $2,977,000.

5.2.3.4 Alternative 3-3B: Excavation/Disposal at Monofill on NWS Concord

Description. The excavation and disposal at a monofill on NWS Concord option consists of excavating contaminated materials followed by disposal in a land disposal facility located on NWS Concord. Only materials excavated from the remedial action site would be placed in the monofill. The monofill would be constructed to Class I standards. The major components of this alternative include: excavation of contaminated materials, transportation of the contaminated materials to the appropriate disposal site, disposal, long term monitoring of the remediation area, and long term monitoring f the disposal area. The primary means of transportation assumed for planning purposes is in lined and covered dump trucks with a capacity of approximately 18 cubic yards. A survey of suitable sites for construction of a disposal facility on NWS Concord was conducted by Lutton et al (1987). Potential sites are shown on Plate 5.2. None of these sites meet State of California facility siting requirements for a Class I facility.

Environmental and Public Health Screening. This alternative provides substantial remediation of ecological and health hazards associated with contaminated soils in RASS 3, including possible transport of contaminated materials to RASS 1 and RASS 2 and eventually to Suisun Bay.

Alternative 3-3B presents the potential for adverse effects caused by exposure of construction personnel and persons located between the area of excavation and disposal to the excavated materials during transport of the materials to disposal facilities. The excavation of contaminated materials would also impact the freshwater wetlands found in RASS 3 and would impact resident wildlife populations by death or displacement. Over time, however, the area of excavation will tend to silt in and the vegetation would recover. These short term impacts would be offset by the potential for long term recovery of the remediation area once the contaminated materials have been removed. Anticipated short term impacts can be minimized by proper planning of construction activities.

Trucks would be used for transporting contaminated soils to land disposal facilities. The disposal of contaminated materials on NWS Concord minimizes the risk of exposing the general public to contaminated materials during transport of these materials to disposal facilities. The increase in truck traffic would cause noise pollution and a possible increase in accidents, which could cause loss of life, air pollution, and increased exposure to spilled contaminated materials for personnel on NWS Concord and public transportation corridors traversing NWS Concord.

Alternative 3-3B provides long term environmental protection at the expense of significant short term impacts. In the long term, natural regrowth of vegetation would substantially eliminate any short term impacts. Rapid recovery of RASS 3 following drainage maintenance activities has been observed.

Engineering Feasibility. The technologies proposed for implementation under Alternative 3-3B are standard engineering and scientific practices that can be executed without project delay. Primary technical concerns include the ability to excavate in wetlands, the moisture content of the excavated materials, the load bearing strength of the soils being excavated (will they support construction equipment), sedimentation effects on areas not selected for active remediation, and transporation and disposal of Class I materials. Difficulties may also be encountered in the development of proposed action levels.

Excavation of contaminated materials from wetlands may present problems in execution of this alternative. Several excavation techniques are available that can excavate the contaminated wetland materials. A combination of bulldozers, clamshell, frontend loaders, and dump trucks can be used for excavation. In order to minimize technical problems associated with excavation, excavation activities should be scheduled for the dry season. This may increase the fugitive dust problem; however, this can be controlled by sprinkling or other dust control measures. Excavation during the dry season will also minimize the potential problem of free liquids in the contaminated soils. Sedimentation effects on adjacent areas can be controlled by existing technology.

Transportation of contaminated materials to the monofill would be by truck or rail. Both truck and rail transportation of contaminated soils are proven technologies. The loss of contaminated materials will be minimized through the use of liners and covers.

Disposal of soils containing high levels of heavy metals and arsenic in a Class I landfill is a proven technology. Although there are usually technical concerns over the possibility that the landfill will leak, these concerns are usually addressed through the implementation of siting controls and engineered features such as liners and leak detection systems. There are several Class I landfills in operation that can accept the types of materials that will be excavated from RASS 1.

The proposed environmental monitoring techniques are standard engineering and scientific practices that can be executed without project delay. Care must be taken to ensure that the sample size for the biological monitoring is sufficient and organized in a way to allow for evaluation of statistical significance. Difficulties may be encountered in the development of proposed action levels; however, these difficulties are not expected to present a major obstacle to execution of this alternative.

<u>Costs</u>. The present worth cost of Alternative 3-3B is estimated to be $3,012,000.

5.2.3.5 Alternative 3-3C: Excavation/Immobilization/Disposal at Existing Landfills

Description. The excavation/immobilization/disposal at existing landfills alternative consists of excavating contaminated materials, immobilization of the contaminants by addition of chemical reagents, land disposal at an existing licensed land disposal facility, and long term monitoring of the remediation area. The excavated materials would be classified into the appropriate categories (Class I, Class II, and Class III). Class I and Class II materials would be treated with chemical reagents to immobilize the contaminants. This process is generally referred to as chemical solidification/stabilization (USEPA 1986a). Typical solidification/stabilization methods include the addition of 25-100 percent by weight of cement, pozzolanic, or proprietary materials. It is assumed that this process is capable of immobilizing the contaminants and the materials will be suitable for disposal in a Class III land disposal facility. The major components of this alternative include: excavation of contaminated materials, classification of the contaminated materials, immobilization of contaminants in Class I and Class II wastes, transportation of the contaminated materials to the appropriate disposal facility, disposal, and implementation of a long term monitoring program. The primary means of transportation assumed for planning purposes is in lined and covered dump trucks with a capacity of approximately 18 cubic yards. A survey of disposal facilities is presented in Table 5.1. These facilities have indicated that they are licensed to dispose of the types of waste materials that will be generated by the remediation activities anticipated in RASS 3.

Environmental and Public Health Screening. This alternative provides for substantial remediation of ecological and health hazards associated with contaminated soils in RASS 3, including possible transport of contaminated materials to other important ecosystems such as those found in RASS 1, RASS 2, and Suisun Bay.

Excavation of contaminated materials presents the potential for adverse effects caused by exposure of construction personnel and the general public to the excavated materials during transport of the materials to existing disposal

facilities. Impacts on the general public would be minimized because the contaminants would be immobilized in the soil. Fugitive dust may be a problem; however, this can be minimized through proper planning and design. The excavation of contaminated materials would impact freshwater wetlands found in RASS 3 and would also impact resident wildlife populations by death or displacement. Over time, however, the area of excavation would tend to silt in and the vegetation would recover. These short term impacts would be offset by the potential for long term recovery of the area once the contaminated materials have been removed. Anticipated short term impacts can be minimized by proper planning of construction activities.

Trucks would be used for transporting the treated soils to land disposal facilities. Therefore, disposal of contaminated materials in existing landfills has the additional risk of exposure of the general public to contaminated materials during transport of these materials to the disposal facilities. Although the trucks would be lined and covered, passage of the trucks through towns and communities would raise community concerns. Additional truck traffic would cause noise pollution and a possible increase in accidents, which could cause loss of life, air pollution, and increased exposure to spilled contaminated materials. These concerns would be reduced somewhat because contaminants would be immobilized in the soil.

Alternative 3-3C provides long term environmental protection at the expense of significant short term impacts. In the long term, natural regrowth of vegetation would substantially eliminate any short term impacts. Rapid recovery of RASS 3 has been observed following drainage maintenance activities.

<u>Engineering Feasibility</u>. The technologies proposed for implementation under Alternative 3-3C are standard engineering and scientific practices that can be executed without project delay. Primary technical concerns include the ability to excavate in wetlands, the moisture content of the excavated materials, the load bearing strength of the soils being excavated (will they support construction equipment), sedimentation effects on areas not selected for active remediation, transporation and disposal of Class III materials, development of solidification/stabilization process, and development of proposed action levels for the environmental monitoring program.

Several excavation techniques are available that can excavate the contaminated wetland materials. A combination of bulldozers, clamshells, frontend loaders, and dump trucks can be used for excavation. In order to minimize technical problems, excavation activities should be scheduled for the dry season. This may increase the fugitive dust problem; however, this can be controlled by sprinkling or other dust control measures. Excavation during the dry seasons will also minimize the potential problem of free liquids in the contaminated soils.

Transportation of contaminated materials to existing landfills would be by truck, which is a proven technology. The loss of contaminated materials would be minimized through the use of liners and covers.

Co-disposal of solidified/stabilized soils in an existing Class III landfill may raise technical concerns over the long term durability of such materials in the Class III environment. Special placement procedures would have to be implemented. Co-disposal may be prohibited by regulatory authorities.

Solidification/stabilization of wastes containing high levels of heavy metals has been demonstrated; however, the process must be developed on a site specific basis. Implementation of a solidification/stabilization technology in California is complicated by the two phase test procedure (TTLC/STLC) and the use of a citric acid extraction that is substituted for the acetic acid extraction of the U.S. EPA's Extraction Procedure. Solidification/stabilization does not remove the metals, and other than for the dilution effects caused by adding large amounts of binder, the TTLC is essentially unchanged. The citric acid extraction is generally believed to be more rigorous than the acetic acid extraction and the data base for successful solidification/stabilization when using a citric acid extraction is limited. Discussions with State of California regulatory personnel (Tornatele 1988) indicated that some success has been demonstrated in reducing the STLC and that special waivers of the TTLC requirement can be obtained when solidification/stabilization is implemented.

The proposed environmental monitoring techniques are standard engineering and scientific practices that can be executed without project delay. Care must be

taken to ensure that the sample size for the biological monitoring is sufficient and organized in a way to allow for evaluation of statistical significance. Difficulties may be encountered in the development of proposed action levels; however, these difficulties are not expected to present a major obstacle to execution of this alternative.

Costs. The present worth cost of Alternative 3-3C is estimated to be $2,209,000.

5.2.3.6 Alternative 3-3D: Excavation/Immobilization/Disposal at Monofill on NWS Concord

Description. The excavation/immobilization/monofill disposal alternative consists of excavating contaminated materials, immobilization of the contaminants by addition of chemical reagents, and land disposal in a monofill located on NWS Concord. The excavated materials will be classified into the appropriate categories (Class I, Class II, and Class III). Class I and Class II materials would be treated with chemical reagents to immobilize the contaminants. This process is generally referred to as chemical solidification/stabilization (USEPA 1986). Typical solidification/stabilization methods include the addition of 25-100 percent by weight of cement, pozzolanic, and/or proprietary materials. It is assumed that this process is capable of immobilizing the contaminants and the materials will be suitable for disposal in a land disposal facility constructed to Class III standards. The major components of this alternative include: excavation of contaminated materials, classification of the contaminated materials, immobilization of contaminants in Class I and Class II wastes, transportation of the contaminated materials to the disposal site, disposal in a monofill constructed on NWS Concord, long term monitoring of the remediation site, and long term monitoring of the monofill. The primary means of transportation assumed for planning purposes is in lined and covered dump trucks with a capacity of approximately 18 cubic yards.

Environmental and Public Health Screening. This alternative provides substantial remediation of ecological and health hazards associated with contaminated soils in RASS 3, including possible transport of contaminated

materials to other important ecosystems such as those found in RASS 1, RASS 2, and Suisun Bay.

Excavation of contaminated materials presents the potential for adverse effects caused by exposure of construction personnel and persons located on NWS Concord to the excavated materials during transport of the materials from the site of excavation to the monofill. Impacts on the general public would be minimized because the contaminants would be immobilized in the soil and the contaminated soils will be disposed of on NWS Concord. Fugitive dust may be a problem; however, this can be minimized through proper planning and design. The excavation of contaminated materials would impact freshwater wetlands found in RASS 3 and would impact resident wildlife populations by death or displacement. Over time, however, the area of excavation will tend to silt in and the vegetation would recover. These short term impacts would be offset by the potential for long term recovery of the area once the contaminated materials have been removed. Anticipated short term impacts can be minimized by proper planning of construction activities.

Trucks would be used for transporting contaminated soils to the monofill. Therefore, the disposal of materials on NWS Concord has the additional risk of exposing personnel on NWS Concord to contaminated materials during transport of these materials to the disposal facilities. Additional truck traffic would cause noise pollution and a possible increase in accidents, which could cause loss of life, air pollution, and increased exposure to spilled contaminated materials. These impacts are limited to NWS Concord and public transportation corridors traversing NWS Concord.

Alternative 3-3D provides long term environmental protection at the expense of rather severe short term impacts. In the long term, natural regrowth of vegetation would substantially eliminate any short term impacts.

Engineering Feasibility. The technologies proposed for implementation under Alternative 3-3D are standard engineering and scientific practices. Primary technical concerns include the ability to excavate in wetlands, the moisture content of the excavated materials, the load bearing strength of the soils being excavated (will they support construction equipment), sedimentation

effects on areas not selected for active remediation, transporation and disposal of Class III materials, development of an adequate solidification/stabilization process, and development of a monofill, and development of proposed action levels for the environmental monitoring program.

Several excavation techniques are available that can excavate the contaminated wetland materials. A combination of bulldozers, clamshells, frontend loaders, and dump trucks can be used for excavation. In order to minimize technical problems, excavation activities should be scheduled for the dry season. This may increase the fugitive dust problem; however, this can be controlled by sprinkling or other dust control measures. Excavation during the dry seasons will also minimize the potential problem of free liquids in the contaminated soils. Sedimentation effects on adjacent areas can be controlled by existing technology.

Transportation of contaminated materials to the monofill would be by truck, which is a proven technology. The loss of contaminated materials would be minimized through the use of liners and covers. In addition, the contaminants would be immobilized in the soil by the solidification/stabilization process.

Disposal of solidified/stabilized soils in a monofill located on NWS Concord may raise technical concerns over the long term durability of such materials. Because of these concerns and the results of the geological investigations conducted by Lutton et al (1987) any monofill constructed on NWS Concord should be designed to meet Class I engineering standards. Use of Class I engineering standards, combined with the relatively limited mobility of metals, would provide long term security for disposal of the solidified/stabilized materials. None of the available monofill sites on NWS Concord meet State of California siting requirements for a Class I facility.

Solidification/stabilization of wastes containing high levels of heavy metals has been demonstrated; however, the process must be developed on a site specific basis. Implementation of a solidification/stabilization technology in California is complicated by the two phase test procedure (TTLC/STLC) and the use of a citric acid extraction that is substituted for the acetic acid extraction of the U.S. EPA's Extraction Procedure.

Solidification/stabilization does not remove the metals, and other than the dilution effects caused by adding large amounts of binder, the TTLC is essentially unchanged. The citric acid extraction is generally believed to be more rigorous than the acetic acid extraction and the data base for successful solidification/stabilization when using a citric acid extraction is limited. Discussions with State of California regulatory personnel (Tornatele 1988) indicated that some success has been demonstrated in reducing the STLC and that special waivers of the TTLC requirement can be obtained when solidification/stabilization is implemented.

The environmental monitoring techniques are standard engineering and scientific practices that can be executed without project delay. Care must be taken to ensure that the sample size for the biological monitoring is sufficient and organized in a way to allow for evaluation of statistical significance. Difficulties may be encountered in the development of proposed action levels; however, these difficulties are not expected to present a major obstacle to execution of this alternative.

Costs. The present worth cost of Alternative 3-3D is estimated to be $3,573,000.

5.2.3.7 Alternative 3-3E: Excavation/Soil Washing/Disposal at Existing Landfills

Description. This alternative consists of excavation of the contaminated soils and removal of the contamination by chemical washing (Nash amd Traver 1986). The washed soils would be transported to an existing Class III land disposal facility. The soil washing would be accomplished by pumping an aqueous solution of acids, bases, surfactants, chelating agents, or any combination thereof, through a series of three upflow soil column reactors. The contaminated washing solutions would be treated for recycling of the washing agents. The resulting waste sludges would be treated and transported to an existing Class I disposal facility. Major components of this alternative include: large scale pilot study, excavation, soil washing, transportation of treated soils and sludges to existing disposal facilities of the appropriate

class, disposal of the materials in an appropriate class of landfill, and long term monitoring of the remediation area.

Environmental and Public Health Screening. This alternative provides substantial remediation of ecological and health hazards associated with contaminated soils in RASS 3, including possible transport of contaminated materials to other important ecosystems such as those found in RASS 1, RASS 2, and Suisun Bay.

Excavation of contaminated materials presents the potential for adverse effects caused by exposure of construction personnel and the general public to the excavated materials during transport of the materials to existing disposal facilities. Impacts on the general public from the contaminated soils will be minimized because the contaminants would be removed by the soil washing process. An effluent stream of contaminated sludges requiring transport to a Class I land disposal facility would be generated. The amount of sludge is estimated to be twenty percent of the volume of treated soil. Fugitive dust may be a problem; however, this can be minimized through proper planning and design. The excavation of contaminated materials would impact the freshwater wetlands found in RASS 3 and would impact resident wildlife populations by death or displacement. Over time, however, the area of excavation will tend to silt in and the vegetation would recover. These short term impacts would be offset by the potential for long term recovery of the area once the contaminated materials have been removed. Anticipated short term impacts can be minimized by proper planning of construction activities.

Trucks would be used for transporting treated soils to land disposal facilities. Either truck or rail would be used to transport residual sludges to Class I disposal facilities. Disposal of sludges in existing landfills has the additional risk of exposing the general public to contaminated materials during transport of these materials to disposal facilities. Although the trucks would be lined and covered, passage of the trucks through towns and communities would raise community concerns. Additional truck traffic would cause noise pollution and a possible increase in accidents, which could cause loss of life, air pollution, and increased exposure to spilled contaminated

materials. Since the soil washing removes and concentrates contaminants, the potential exposure to contaminated materials should be reduced.

Alternative 3-3E provides long term environmental protection at the expense of significant short term impacts. In the long term, natural regrowth of vegetation would substantially eliminate any short term impacts.

Engineering Feasibility. Except for the soil washing technology, the technologies proposed for implementation under Alternative 3-3E are standard engineering and scientific practices. The overriding technical concern associated with this alternative is development of a soil washing process. Other technical concerns include the ability to excavate in wetlands, the moisture content of the excavated materials, the load bearing strength of the soils being excavated (will they support construction equipment), sedimentation effects on areas not selected for active remediation, transportation and disposal of Class III materials, transportation and disposal of Class I materials, and development of proposed action levels for the environmental monitoring program.

Several excavation techniques are available that can be used to excavate the contaminated wetland materials. A combination of bulldozers, clamshells, frontend loaders, and dump trucks can be used for excavation. In order to minimize technical problems, excavation activities should be scheduled for the dry season. This may increase the fugitive dust problem; however, this can be controlled by sprinkling or other dust control measures. Excavation during the dry seasons will also minimize the potential problem of free liquids in the contaminated soils. Sedimentation effects on adjacent areas can be controlled by existing technology.

Although it is expected that the cleaned soils will be suitable for unrestricted use, for cost estimating purposes, it is assumed that the materials will be disposed of in a Class III landfill. Transportation of decontaminated materials to the monofill would be by truck, which is a proven technology. The loss of materials will be minimized through the use of liners and covers. Since it is expected that the decontaminated soils will be suitable for unrestricted use, materials loss would not be a critical technical issue. The

sludge produced by the soil washing process would be transported to an existing Class I facility by truck or rail. Both truck and rail transportation of contaminated soils are proven technologies. The loss of contaminated materials will be minimized through the use of liners and covers.

Although demonstrated to some degree in the mining and ore processing industry, soil washing for removal of arsenic and heavy metals from contaminated soils has not been proven in a large scale remedial action. The process is developmental and would require additional laboratory and pilot scale study before implementation on a scale of the proposed remedial action for RASS 1. Personnel communications (Tetra Resources 1988, Environmental Field Services 1988, OH Materials 1987, USEPA 1987) indicates conflicting opinions on the technical feasibility of soil washing. If the soil washing process proves to be technically feasible, two waste streams are produced: the decontaminated soils and a sludge containing the heavy metals removed from the soil. It is assumed that the soil will be cleaned sufficiently for unrestricted use; however, the sludge containing the heavy metals will be a Class I and possibly a RCRA waste.

The proposed environmental monitoring techniques are standard engineering and scientific practices that can be executed without project delay. Care must be taken to ensure that the sample size for the biological monitoring is sufficient and organized in a way to allow for evaluation of statistical significance. Difficulties may be encountered in the development of proposed action levels; however, these difficulties are not expected to present a major obstacle to execution of this alternative.

Costs. The present worth cost of Alternative 3-3E is estimated to be $4,369,000.

5.2.3.8 Alternative 3-3F: Excavation/Soil Washing/Disposal at Monofill on NWS Concord

Description. This alternative consists of excavation of the contaminated soils and removal of the contamination by chemical washing (Nash and Traver 1986). Excavated soils will be classified into Class I, Class II, and

Class III materials. Class I and II wastes will be treated. The washed soils would be transported to a monofill on NWS Concord constructed to Class III standards. The soil washing would be accomplished by pumping an aqueous solution of acids, bases, surfactants, chelating agents, or any combination thereof, through a series of three upflow soil column reactors. The contaminated washing solutions would be treated for recycling of the washing agents. The resulting waste sludges would be treated and transported to an existing Class I disposal facility. Major components of this alternative include: large scale pilot study, excavation, soil washing, transport of treated soils to a Class III monofill located on NWS Concord, transport of sludges to an existing Class I disposal facility, disposal of the materials in the appropriate class of landfill, long term monitoring of the monofill, and long term monitoring of the remediation area.

Environmental and Public Health Screening. This alternative could provide for substantial remediation of ecological and health hazards associated with contaminated soils in RASS 3, including possible transport of contaminated materials to other important ecosystems such as those found in RASS 1, RASS 2, and Suisun Bay.

Excavation of contaminated materials presents the potential for adverse effects caused by exposure of construction personnel and persons located on NWS Concord to the excavated materials. Impacts on the general public from the contaminated soils will be minimized because the contaminants would be removed by the soil washing process and the cleaned soil would be disposed of on NWS Concord . An effluent stream of contaminated sludges would be generated that would require transport to a Class I land disposal facility. The quantity of sludge is estimated to be twenty percent of the volume of treated soils. Fugitive dust may be a problem; however, this can be minimized through proper planning and design.

The excavation of contaminated materials will also impact the freshwater wetlands found in RASS 3 and would impact resident wildlife populations by death or displacement. Over time, however, the area of excavation will tend to silt in and the vegetation would recover. These short term impacts would be offset by the potential for long term recovery of the area once the contaminated

materials have been removed. Anticipated short term impacts can be minimized by proper planning of construction activities.

Trucks would be used for transporting treated soils to the monofill. The disposal of decontaminated soils on NWS Concord reduces the risk of exposing the general public to contaminated materials during remediation activities. Sludges generated by the soil washing process would be transported by truck or rail to an existing Class I disposal facility. Although the trucks would be lined and covered, passage of the trucks through NWS Concord and surrounding towns and communities would raise community concerns. Additional truck traffic would cause noise pollution and a possible increase in accidents, which could cause loss of life and air pollution. Since the decontaminated soils would be disposed of on NWS Concord, the transportation of Class I materials would be minimized.

Alternative 3-3F provides long term environmental protection at the expense of significant short term impacts. In the long term, natural regrowth of vegetation would substantially eliminate any short term impacts. Rapid recovery of RASS 3 following drainage maintenance activities has been observed.

Engineering Feasibility. Except for the soil washing technology, the technologies proposed for implementation under Alternative 3-3F are standard engineering and scientific practices. The overriding technical concern associated with this alternative is development of a soil washing process. Other technical concerns include the ability to excavate in wetlands, the moisture content of the excavated materials, the load bearing strength of the soils being excavated (will they support construction equipment), sedimentation effects on areas not selected for active remediation, transportation and disposal of Class III materials, transportation and disposal of Class I materials, and development of proposed action levels for the environmental monitoring program.

Several excavation techniques are available that can be used to excavate the contaminated wetland materials. A combination of bulldozers, clamshells, frontend loaders, and dump trucks can be used for excavation. In order to minimize technical problems, excavation activities should be scheduled for the

dry season. This may increase the fugitive dust problem; however, this can be controlled by sprinkling or other dust control measures. Excavation during the dry seasons will also minimize the potential problem of free liquids in the contaminated soils.

Although it is expected that the cleaned soils will be suitable for unrestricted use, for cost estimating purposes, it is assumed that the materials will be disposed of in a Class III landfill. Transportation of decontaminated materials to the monofill would be by truck, which is a proven technology. The loss of materials will be minimized through the use of liners and covers. Since it is expected that the decontaminated soils will be suitable for unrestricted use, materials loss would not be a critical technical issue. The sludge produced by the soil washing process would be transported to an existing Class I facility by truck or rail. Both truck and rail transportation of contaminated soils are proven technologies. The loss of contaminated materials will be minimized through the use of liners and covers.

Although demonstrated to some degree in the mining and ore processing industry, soil washing for removal of arsenic and heavy metals from contaminated soils has not been proven in a large scale remedial action. The process is developmental and would require additional laboratory and pilot scale study before implementation on a scale of the proposed remedial action for RASS 3. Personnel communications (Tetra Resources 1988, Environmental Field Services 1988, OH Materials 1987, USEPA 1987) indicates conflicting opinions on the technical feasibility of soil washing. If the soil washing process proves to be technically feasible, two waste streams are produced: the decontaminated soils and a sludge containing the heavy metals removed from the soil. It is assumed that the soil will be cleaned sufficiently for unrestricted use; however, the sludge containing the heavy metals will be a Class I and possibly a RCRA waste.

The proposed environmental monitoring techniques are standard engineering and scientific practices that can be executed without project delay. Care must be taken to ensure that the sample size for the biological monitoring is sufficient and organized in a way to allow for evaluation of statistical significance. Difficulties may be encountered in the development of proposed

action levels; however, these difficulties are not expected to present a major obstacle to execution of this alternative.

Costs. The present worth cost of Alternative 3-3F is estimated to be $5,285,000.

5.2.3.9 Alternative 3-4A: Source Isolation/Soil Cover

Description. This alternative examines the use of a soil/vegetative cover to reduce the possibility of erosion and direct contact with the contaminated soil materials. The contaminated soil materials located in RASS 2 would not be removed. The primary components of this alternative include: site preparation, placement of a soil cover, grading, revegetation of the cover, and long term monitoring of the remediation area.

Environmental and Public Health Screening. This alternative will substantially eliminate the potential for exposure of biota or humans through direct contact with the highly contaminated surficial soils, and it would prevent resuspension and redistribution of the contaminated soils into adjacent uncontaminated or lightly contaminated areas. Furthermore, migration of contaminants into RASS 1, RASS 2, and Suisun Bay from RASS 3 would be prevented. Prevention of biota contact with the contaminated soils would prevent food chain transfer of the contaminants to humans and reduce or eliminate potential health effects of concern.

Although the implementation of the soil cap would prevent further migration of contaminants into adjacent areas, there would be long term adverse impacts associated with raising the natural elevation of RASS 3. The top soil cover would raise the ground elevation a minimum of 4 ft. Significant portions of RASS 3 would be converted into upland and a transition zone. Regulatory issues would be raised with any proposal to fill and destroy wetlands with a resultant loss of habitat.

Engineering Feasibility. The technologies proposed for implementation under Alternative 3-4A are standard engineering and scientific practices. Technical concerns include the ability to construct a soil cap on the wetland, the load

bearing strength of the soils on which the cap would be constructed (will they support the cap without excessive long term maintenance), sedimentation effects on areas not selected for active remediation, and development of proposed action levels for the environmental monitoring program.

Construction of the soil cap will be similar to a filling operation, which is a proven technology. Adequate geotechnical design procedures are available to ensure that the cap is durable and performs its intended purpose. RASS 3 consists primarily of a freshwater wetland and flowing stream. Soil caps have not been demonstrated for application in an environment similar to RASS 3. Because of the irregular nature of the contaminated areas requiring remediation, there is some question regarding the engineering feasibility of constructing a cap in this environment. Erosion of the cap would be likely to occur. Successful implementation of a soil cap in RASS 3 would require significant changes to existing drainage patterns, affecting both upstream and downstream property owners. Sedimentation effects on adjacent areas can be controlled by existing technology.

The proposed environmental monitoring techniques are standard engineering and scientific practices that can be executed without project delay. Care must be taken to ensure that the sample size for the biological monitoring is sufficient and organized in a way to allow for evaluation of statistical significance. Difficulties may be encountered in the development of proposed action levels; however, these difficulties are not expected to present a major obstacle to execution of this alternative.

Costs. The present worth cost of Alternative 3-4A is estimated to be $2,147,000.

5.2.3.10 Alternative 3-4B: Source Isolation/RCRA Cap

Description. This alternative examines the use of a multilayered cover (RCRA cap) to reduce the possibility of erosion and direct contact with the contaminated soil material. The contaminated soil materials located in RASS 3 would not be removed. The primary components of this alternative include: site preparation, placement of a cover meeting RCRA requirements, grading, and

revegetation of the cover. At a minimum, the RCRA cap would include a 2 ft thick low permeability (10^{-7}) soil layer, a 12 in. drainage layer, a 20 mil synthetic membrane with bedding, and a 2 ft layer of topsoil. Finally, the cover would be graded and revegetated. A cross-section of the proposed RCRA cap is illustrated in Plate 5.3.

Environmental and Public Health Screening. This alternative will substantially eliminate the potential for exposure of biota or humans through direct contact with the highly contaminated surficial soils, and it would prevent resuspension and redistribution of the contaminated soils into adjacent uncontaminated areas. Furthermore, migration of contaminants into Suisun Bay would be prevented. Prevention of biota contact with the contaminated soils would prevent food chain transfer of the contaminants to humans and reduce or eliminate potential health effects of concern. Implementation of the RCRA cap alternative would also prevent the transport of contamination into the underlying groundwater.

Although the implementation of the RCRA cap would prevent further migration of contaminants into adjacent areas and ground water, there would be long term adverse impacts associated with raising the natural elevation of RASS 3. The RCRA cover would raise the ground elevation a minimum of 6 ft. Significant portions of RASS 3 would be converted into upland and a transition zone. Regulatory issues would be raised with any proposal to fill and destroy wetlands with a resultant loss of habitat.

Engineering Feasibility. The technologies proposed for implementation under Alternative 3-4B are standard engineering and scientific practices. Technical concerns include the ability to construct a RCRA cap on the wetland, the load bearing strength of the soils on which the cap would be constructed (will they support the cap without excessive long term maintenance), sedimentation effects on areas not selected for active remediation, and development of proposed action levels for the environmental monitoring program.

Construction of the RCRA cap will be similar to a filling operation, which is a proven technology. Adequate geotechnical design procedures are available to ensure that the cap is durable and performs its intended purpose. RASS 3

consists primarily of a freshwater wetland and flowing stream. RCRA caps have not been demonstrated for application in an environment similar to RASS 3. Because of the irregular nature of the contaminated areas requiring remediation, there is some question regarding the engineering feasibility of constructing a cap in this environment. Erosion of the cap would be likely to occur. Successful implementation of a RCRA cap in RASS 3 would require significant changes to existing drainage patterns, affecting both upstream and downstream property owners. Sedimentation effects on adjacent areas can be controlled by existing technology.

The proposed environmental monitoring techniques are standard engineering and scientific practices that can be executed without project delay. Care must be taken to ensure that the sample size for the biological monitoring is sufficient and organized in a way to allow for evaluation of statistical significance. Difficulties may be encountered in the development of proposed action levels; however, these difficulties are not expected to present a major obstacle to execution of this alternative.

Costs. The present worth cost of Alternative 3-4B is estimated to be $3,046,000.

5.2.3.11 Alternative 3-6A: In Situ Stabilization

Description. The in situ stabilization alternative consists of injecting the in place contaminated soils with chemical reagents to immobilize the contaminants in the soil. The process is similar to the excavation/immobilization alternatives (Alternative 3-3C and 3-3D), except that the binder chemicals are mixed with the inplace soils and the contaminated soils are not excavated. The major components of this alternative include: development of a solidification/stabilization process, stripping of vegetation, application of the solidification/stabilization binder, revegetation, periodic reapplication of the binder, and long term environmental monitoring of the remediation area.

Environmental and Public Health Screening. This alternative provides limited remediation of the ecological and health hazards associated with the

contaminated soils in RASS 3. The primary mechanism of the in situ stabilization process is to reduce the solubility of the metals and thereby reduce their bioavailability. The in situ immobilization process does not remove the metals from the soils. Metals would be available to migrate with any soil or sediment that is physically moved by hydrologic processes. Because of the dynamic hydrologic environment of RASS 3, it is probable that continued migration of contaminants would occur.

Since the metals would remain in the soil, the potential for direct contact would remain. In situ stabilization would reduce the availability of the contaminants.

Because physical migration would be likely, mere chemical stabilization of the soils would not be totally effective in reducing contaminant migration. The soils could be physically stabilized by adding sufficient binder materials; however, addition of binder materials in the quantities required for physical stabilization would most probably have environmental consequences similar to the capping alternatives, i.e, the nature of the habitat would be substantially changed and would probably not support the species currently living on the site.

In situ stabilization requires periodic reapplication of binder materials. It is estimated that reapplication of binder materials would be necessary every five to ten years. Reapplication would involve similar activities to the initial application. Because of the maintenance requirements, adverse impacts of the in situ stabilization alternative would be long term and continuing. This alternative would have severe short term impacts as well as major long term adverse impacts.

<u>Engineering Feasibility Evaluation</u>. Primary technical concerns include the ability to apply binder materials in wetlands, the load bearing strength of the soils (will they support construction equipment), sedimentation effects on areas not selected for active remediation, and development of a solidification/ stabilization process that can be applied in situ in the wetlands. Difficulties may also be encountered in the development of proposed action levels.

The primary technology, in situ stabilization, proposed for implementation in this alternative has not been demonstrated on a large scale, nor have they been applied in a wetland environment. Although the technology is similar to solidification/stabilization technology used in the excavation/immobilization alternatives, the excavation alternatives have the advantage that the materials are removed from an active hydrologic environment and the solidification/stabilization processing is accomplished in a controlled environment. Of particular technical concern to this alternative is the long term durability of the treated soils in an active hydrologic environment. Since the in situ stabilization process is oriented towards the chemical immobilization of contaminants, it is likely that physical mobilization will continue.

Solidification/stabilization of wastes, containing high levels of heavy metals has been demonstrated; however, the process must be developed on a site specific basis. In situ stabilization in a wetland environment has not been demonstrated. Implementation of a solidification/stabilization technology in California is complicated by the two phase test procedure (TTLC/STLC) and the use of a citric acid extraction that is substituted for the acetic acid extraction of the U.S. EPA's EP.

Solidification/stabilization does not remove the metals, and other than the dilution effects caused by adding large amounts of binder, the TTLC is essentially unchanged. The citric acid extraction is generally believed to be more rigorous than the acetic acid extraction and the data base for successful solidification/stabilization when using a citric acid extraction is limited. Discussions with State of California regulatory personnel (Tornatele 1988) indicated that some success has been demonstrated in reducing the STLC and that special waivers of the TTLC requirement can be obtained when solidification/stabilization is implemented. The potential technical problems are compounded in this alternative because the alternative leaves the treated materials in an active environment rather than placing them in a controlled landfill environment. Sedimentation effects on adjacent areas can be controlled by existing technology.

The proposed environmental monitoring techniques are standard engineering and scientific practices that can be executed without project delay. Care must be taken to ensure that the sample size for the biological monitoring is sufficient and organized in a way to allow for evaluation of statistical significance. Difficulties may be encountered in the development of proposed action levels; however, these difficulties are not expected to present a major obstacle to execution of this alternative.

Overall, because of site specific reasons, the engineering feasibility of this alternatives is low.

Costs. The present worth costs of Alternative 3-6A is estimated to be $2,618,000.

5.2.3.12 Alternative 3-6B: Soil Flushing

Description. The soil flushing alternative consists of injecting a soil washing solution to dislodge, solubilize, or other wise remove the contaminants from the soils. Chemically, the soil flushing alternative is similar to the soil washing alternatives (Alternative 3-3E and 3-3F). Possibly flushing agents include water, acids, bases, chelating agents, and/or surfactants. The major components of this alternative include: development of a soil washing process that is effective for the contaminants found on RASS 3, construction of a flushing agent application and recovery system, application and recovery of the soil flushing agents, treatment of the recovered soil flushing agents, disposal of residual sludges and flushing agents, and environmental monitoring of the remediation area.

Environmental and Public Health Screening. This alternative provides substantial remediation of ecological and health hazards associated with the contaminated soils in RASS 3, including possible transport of contaminated materials to other important ecosystems such as Suisun Bay.

The soil flushing process produces an effluent stream of sludges that will be classified as Class I and possibly RCRA wastes. The amount of sludge would be similar to that produced in the soil washing alternatives and is estimated to

be approximately 20 percent of the treated soils. The residual sludges would be transported to an existing Class I landfill for disposal. Lined and covered trucks or rail cars would be the primary means of transport. Transport of these materials has the additional risk of exposure of the general public to contaminated materials. Passage of the trucks and rail cars through populated areas may raise community concerns. Additional traffic would cause noise pollution, and a possible increase in accidents, which could cause loss of life, air pollution, and increased exposure to contaminated materials.

The construction of soil flushing reagent application and recovery system would cause severe short term disruption of the habitat in RASS 3. Anticipated short term impacts could be minimized by proper planning of construction activities; however, since the application and recovery of the soil flushing reagents may take several seasons, short term impacts may occur for a substantial period of time.

In addition to the disruption caused by construction activities, some soil flushing reagents may be toxic or hazardous. Since 100 percent recovery of the soil flushing reagents is unlikely, soil flushing may have a detrimental impact on the plant and wildlife in RASS 3.

Alternative 3-6B provides long term environmental protection at the expense of significant short term impacts.

Engineering Feasibility. Soil flushing technology is not considered to be a standard engineering or scientific technology for remediation of contaminated sites. The overriding technical concern associated with this alternative is development of a soil flushing process. Other technical concerns include the load bearing strength of the soils, (will they support construction equipment), the permeability of the soils (can the flushing agents be recovered), sedimentation effects on areas not selected for active remediation, transportation and disposal of Class I materials, and development of proposed action levels for the environmental monitoring program.

The chemistry of soil flushing is similar to that of soil washing. The process is developmental and would require additional laboratory and pilot

scale study before implementation on a scale of the proposed remedial action for RASS 3. If the soil washing process proves to be technically feasible, a sludge containing the heavy metals removed from the soil would require disposal. It is assumed that the soil will be cleaned sufficiently for unrestricted use; however, the sludge containing the heavy metals will be a Class I and possibly a RCRA waste.

Construction of a flushing agent application and recovery system in the wetland environments will be technically difficult. Although construction could be scheduled for the dry season, the low permeability of the soils would necessitate construction of recovery wells or underdrains at a close interval, thus increasing the cost and making complete recovery of the flushing agents difficult. This may be particularly important since some of the reagents used for soil flushing are hazardous materials.

The proposed environmental monitoring techniques are standard engineering and scientific practices that can be executed without project delay. Care must be taken to ensure that the sample size for the biological monitoring is sufficient and organized in away to allow for evaluation of statistical significance. Difficulties may be encountered in the development of proposed action levels; however, difficulties are not expected to present a major obstacle to execution of this alternative.

The engineering feasibility of the soil flushing alternative is considered to be low.

Costs. The present worth cost of Alternative 3-6B is estimated to be $3,942,000.

5.2.4 Alternatives for Remedial Action Subsite 4. Twelve potential remedial action alternatives were initially developed for RASS 4. These included the following.

a. Alternative 4-1: No Action
b. Alternative 4-2: Environmental Monitoring
c. Alternative 4-3A: Excavation/Disposal at Existing Landfills

d. Alternative 4-3B: Excavation/Disposal at Monofill on NWS Concord

e. Alternative 4-3C: Excavation/Immobilization/Disposal at Existing Landfills

f. Alternative 4-3D: Excavation/Immobilization/Disposal at Monofill on NWS Concord

g. Alternative 4-3E: Excavation/Soil Washing/Disposal at Existing Landfills

h. Alternative 4-3F: Excavation/Soil Washing/Disposal at Monofill on NWS Concord

i. Alternative 4-4A: Source Isolation/Soil Cap

j. Alternative 4-4B: Source Isolation/RCRA Cap

k. Alternative 4-6A: In Situ Stabilization

l. Alternative 4-6B: Soil Flushing

5.2.4.1 Alternative 4-1: No Action

Description. The no action alternative involves no additional positive remedial action activities. Soils containing high levels of heavy metals would be left in place. No additional monitoring would be implemented. Warning signs and public education programs would be used to inform the public about potential hazards. Property records would be annotated to document the location of known and suspected contamination.

Environmental and Public Health Screening. The no action alternative would not measurably change the current likelihood of exposure of biota to very high concentrations of arsenic, cadmium, lead, copper, zinc, and selenium. The possibility of direct human contact with the contaminated soils would be only minimally reduced with signs and an education program.

Under the no action alternative, contaminants would continue to migrate from the contaminated area through the pathways described in Section 3. The areal extent of contamination would increase and spread from RASS 4. While the concentrations of heavy metals might be attenuated by natural dilution effects, a wider range of biota will be exposed to the contaminants. The potential environmental effects of the no action alternative are described in detail by Lee et al. (1986).

__Engineering Feasibility__. The technologies proposed for implementation under the No Action alternative are standard engineering practices that can be executed without undue delay.

__Costs__. The present worth cost of the No Action alternative is estimated to be $53,000.

5.2.4.2 __Alternative 4-2: Environmental Monitoring__

__Description__. The environmental monitoring alternative features the no action alternative, i.e., no additional active remediation, augmented by implementation of continued environmental monitoring. Contaminated materials would be left in-place. A two part environmental monitoring program would be implemented to periodically evaluate the environmental status of RASS 4 and those adjacent areas onto which contaminants are likely to migrate. At a minimum, the increased monitoring program would include surface water sampling, soil sampling, bioassays, and wildlife and habitat evaluations.

Phase 1 monitoring includes the collection and analysis of soil, surface water, and ground water. In addition, wildlife and vegetation would be observed and evaluated. Phase 1 sampling would be conducted annually for the first five years and every five years thereafter.

Phase 2 monitoring is oriented towards the evaluation of contaminant impacts on the biota of RASS 4 and adjacent areas. Phase 2 monitoring includes: clam bioaccumulation studies, macroinvertebrate studies, and plant and animal bioaccumulation studies. Phase 2 monitoring would be conducted every two years during the first five years and every five years thereafter.

Monitoring studies would be summarized in an annual report describing the results of the various sampling programs. The report would also contain an assessment of any physical changes in RASS 4 or adjacent areas, i.e., natural improvement or degradation of habitats, man-made alterations, etc. The report would also make recommendations for implementation of any required remedial actions.

Environmental and Public Health Screening. The increased monitoring alternative would not measurably change the likelihood of exposure of biota to very high concentrations of heavy metals. The possibility of direct human contact with contaminated soils would be minimally reduced by posting of contaminated areas and a public education program.

The environmental monitoring program would allow continued migration of heavy metals from the areas of high contaminant concentrations and the areal extent of the contamination would continue to increase. There would be some attenuation of the high levels of contamination because of dilution effects. The potential environmental effects are essentially the same as the no action alternative and are described in Lee et al. (1986). The threat of contamination of plants and wildlife would continue and the potential for exposure would increase as the areal extent of contamination increases.

The environmental monitoring alternative provides only limited positive environmental protection benefits above those provided by the no action alternative. Although the increased monitoring alternative would not eliminate or reduce contamination of soils or surface waters by continued migration of contaminants from current high level areas, increased monitoring would provide documentation of contaminant migration and its environmental impact. Wildlife studies would document species use of RASS 4, the contamination levels of collected species, and problems caused by continuous exposure to the hazardous substances. The environmental monitoring program would also provide an early warning of changes in conditions that may increase the potential for substantial environmental damage by continued contaminant release or an unexpected increase in the rate of release.

Engineering Feasibility. The technologies proposed for implementation under this alternative are standard engineering and scientific practices that can be executed without project delay. Care must be taken to ensure that the sample size for the biological monitoring is sufficient and organized in a way to allow for evaluation of statistical significance. Difficulties may be encountered in the development of proposed action levels; however, these difficulties are not expected to present a major obstacle to execution of this alternative.

Costs. The present worth cost of Alternative 4-2 is estimated to be $541,000.

5.2.4.3 Alternative 4-3A: Excavation/Disposal at Existing Landfills

Description. The excavation and disposal in existing landfill alternative consists of excavating materials in those areas where soil metal content exceeds the TTLC/STLC criterion followed by land disposal at an existing licensed land disposal facility. The excavated materials will be classified into the appropriate categories (Class I, Class II, and Class III) for disposal in the appropriate level landfill. The major components of this alternative include: excavation of contaminated materials, classification of the contaminated materials, transportation of the contaminated materials to the appropriate existing disposal facility, disposal, liming of low pH areas, and long term monitoring of the remediation area. The primary means of transportation assumed for planning purposes is in lined and covered dump trucks with a capacity of approximately 18 cubic yards or covered rail cars with a capacity of 64 cubic yards. A survey of disposal facilities is presented in Table 5.1. These facilities have indicated that they are licensed to dispose of the types of waste materials that will be generated by the remediation activities anticipated in RASS 4.

Environmental and Public Health Screening. This alternative provides substantial remediation of ecological and health hazards associated with contaminated soils in RASS 4.

Excavation of contaminated material presents the potential for adverse effects caused by exposure of construction personnel and the general public to the excavated materials during transport of the materials to existing disposal facilities. These short term impacts would be offset by the potential for long term recovery of the area once the contaminated materials have been removed. Anticipated short term impacts can be minimized by proper planning of construction activities.

Trucks or rail cars would be used for transporting contaminated soils to land disposal facilities. Therefore, disposal of contaminated materials in existing landfills has the additional risk of exposing the general public to

contaminated materials during transport of these materials to disposal facilities. Although the trucks and rail cars would be lined and covered, passage of the trucks and rail cars through towns and communities would raise community concerns. Additional truck traffic would cause noise pollution and a possible increase in accidents, which could cause loss of life, air pollution, and increased exposure to spilled contaminated materials.

Alternative 4-3A provides long term environmental protection at the expense of rather severe short term impacts. In the long term, natural regrowth of vegetation would substantially eliminate any short term impacts.

Engineering Feasibility. The technologies proposed for implementation under Alternative 4-3A are standard engineering and scientific practices that can be executed without project delay. Primary technical concerns include the ability to excavate in wetlands, the moisture content of the excavated materials, the load bearing strength of the soils being excavated (will they support construction equipment), sedimentation effects on areas not selected for active remediation, and transportation and disposal of Class I materials. Difficulties may also be encountered in the development of proposed action levels.

Several excavation techniques are available that can be used to excavate the contaminated materials. A combination of bulldozers, frontend loaders, and dump trucks can be used for excavation. In order to minimize technical problems, excavation activities should be scheduled for the dry season. This may increase the fugitive dust problem; however, this can be controlled by sprinkling or other dust control measures. Sedimentation effects on adjacent areas can be controlled by existing technology such as silt screens.

Transportation of contaminated materials to existing landfills would be by truck or rail. Both truck and rail transportation of contaminated soils are proven technologies. The loss of contaminated materials will be minimized through the use of liners and cover.

Disposal of contaminated soils in a Class I landfill is a proven technology. Although there are usually technical concerns over the possibility that the

landfill will leak, these concerns are usually addressed through the implementation siting controls and engineered features such as liners and leak detection systems. There are several Class I landfills in operation that can accept the types of materials that will be excavated from RASS 1.

The proposed environmental monitoring techniques are standard engineering and scientific practices that can be executed without project delay. Care must be taken to ensure that the sample size for the biological monitoring is sufficient and organized in a way to allow for evaluation of statistical significance. Difficulties may be encountered in the development of proposed action levels; however, these difficulties are not expected to present a major obstacle to execution of this alternative.

Costs. The present worth cost of Alternative 4-3A is estimated to be $265,000.

5.2.4.4 Alternative 4-3B: Excavation/Disposal at Monofill on NWS Concord

Description. The excavation and disposal at a monofill on NWS Concord alternative consists of excavating materials in those areas where soil metal content exceeds the TTLC/STLC criterion followed by disposal in a land disposal facility located on NWS Concord. Only materials excavated from the remedial action site would be placed in the monofill. The monofill would be constructed to Class I standards. The major components of this alternative include: excavation of contaminated materials, transportation of the contaminated materials to the disposal site, disposal, liming of low pH areas, long term monitoring of the monofill, and long term monitoring of the remediation area. The primary means of transportation assumed for planning purposes is in lined and covered dump trucks with a capacity of approximately 18 cubic yards. A survey of suitable sites for construction of a disposal facility on NWS Concord is being conducted. Potential sites are shown on Plate 5.2. None of the sites evaluated meet State of California siting requirements for a Class I facility.

Environmental and Public Health Screening. This alternative provides substantial remediation of ecological and health hazards associated with contaminated soils in RASS 4.

Alternative 4-3B presents the potential for adverse effects caused by exposure of construction personnel and persons located between the area of excavation and disposal to the excavated materials during transport of the materials to the monofill. The excavation of contaminated materials will also impact the resident wildlife populations by death or displacement. Over time, however, the area of excavation would revegetate. Any short term impacts would be offset by the potential for long term recovery of the area once the contaminated materials have been removed. Anticipated short term impacts can be minimized by proper planning of construction activities.

Trucks would be used for transporting contaminated soils to the monofill. The disposal of contaminated materials on NWS Concord minimizes the risk of exposing the general public to contaminated materials during transport of these materials to disposal facilities. The increase in truck traffic would cause noise pollution and a possible increase in accidents, which could cause loss of life, air pollution, and increased exposure to spilled contaminated materials for personnel on NWS Concord and public transportation corridors on NWS Concord.

Alternative 4-3B provides long term environmental protection at the expense of rather severe short term impacts. In the long term, natural regrowth of the contaminated vegetation would substantially eliminate any short term impacts.

Engineering Feasibility. The technologies proposed for implementation under Alternative 4-3B are standard engineering and scientific practices. Primary technical concerns include the moisture content of the excavated materials, the load bearing strength of the soils being excavated (will they support construction equipment), sedimentation effects on areas not selected for active remediation, and transportation and disposal of Class I materials. Difficulties may also be encountered in the development of proposed action levels.

Several excavation techniques are available that can excavate the contaminated materials. A combination of bulldozers, frontend loaders, and dump trucks can be used for excavation. In order to minimize technical problems, excavation activities should be scheduled for the dry season. This may increase the fugitive dust problem; however, this can be controlled by sprinkling or other dust control measures. Sedimentation effects on adjacent areas can be controlled by existing technology such as silt screens.

Transportation of contaminated materials to the monofill would be by truck or rail. Both truck and rail transportation of contaminated soils are proven technologies. The loss of contaminated materials will be minimized through the use of liners and covers.

Disposal of soils containing high levels of heavy metals and arsenic in a Class I landfill is a proven technology. Although there are usually technical concerns over the possibility that the landfill will leak, these concerns are usually addressed through the implementation of siting controls and engineered features such as liners and leak detection systems. An investigation of potential Class I disposal sites on NWS Concord revealed that none of the available sites meet State of California siting requirements for a Class I facility (Lutton et al 1987). Therefore, the technical feasibility of implementing Alternative 4-3B is doubtful.

The proposed environmental monitoring techniques are standard engineering and scientific practices that can be executed without project delay. Care must be taken to ensure that the sample size for the biological monitoring is sufficient and organized in a way to allow for evaluation of statistical significance. Difficulties may be encountered in the development of proposed action levels; however, these difficulties are not expected to present a major obstacle to execution of this alternative.

Costs. The present worth cost of Alternative 4-3B is estimated to be $1,137,000.

5.2.4.5 Alternative 4-3C: Excavation/Immobilization/Disposal at Existing Landfills

Description. The excavation/immobilization/disposal at existing landfills option consists of excavating in those areas where soil metal content exceeds the TTLC/STLC criteria materials, immobilization of the contaminants by addition of chemical reagents, and land disposal at an existing licensed land disposal facility. The excavated materials will be classified into the appropriate categories (Class I, Class II, and Class III). Class I and Class II materials would be treated with chemical reagents to immobilize the contaminants. This process is generally referred to as chemical solidification/stabilization (USEPA 1986a). Typical solidification/stabilization methods include the addition of 25-100 percent by weight of cement, pozzolanic, and/or proprietary materials. It is assumed that this process is capable of immobilizing the contaminants and the resulting materials would be suitable for disposal in a Class III land disposal facility. The major components of this alternative include: excavation of contaminated materials, classification of the contaminated materials, immobilization of contaminants in Class I and Class II wastes, transportation of the contaminated materials to the appropriate disposal facility, disposal, liming of low pH areas, and implementation of a long term monitoring program. The primary means of transportation assumed for planning purposes is in lined and covered dump trucks with a capacity of approximately 18 cubic yards. A survey of disposal facilities is presented in Table 5.1. These facilities have indicated that they are licensed to dispose of the types of waste materials that will be generated by the remediation activities anticipated in RASS 4.

Environmental and Public Health Screening. This alternative could provide for substantial remediation of ecological and health hazards associated with contaminated soils in RASS 4.

Excavation of contaminated materials presents the potential for adverse effects caused by exposure of construction personnel and the general public to the excavated materials during transport of the materials to existing disposal facilities. Impacts on the general public will be minimized because the contaminants should be immobilized in the soil. Fugitive dust may be a problem;

however, this can be minimized through proper planning and design. The excavation of contaminated materials will also impact the resident wildlife populations by death or displacement. Over time, however, the area of excavation would revegetate. These short term impacts would be offset by the potential for long term recovery of the area once the contaminated materials have been removed. Anticipated short term impacts can be minimized by proper planning of construction activities.

Trucks would be used for transporting the treated soils to land disposal facilities. Therefore, the off site disposal of contaminated materials has the additional risk of exposure of the general public to contaminated materials during transport of these materials to the disposal facilities. Although the trucks would be lined and covered, passage of the trucks through towns and communities would raise community concerns. Additional truck traffic would cause noise pollution and a possible increase in accidents, which could cause loss of life, air pollution, and increased exposure to spilled contaminated materials. These concerns would be reduced somewhat because contaminants would be immobilized in the soil.

Alternative 4-3C provides long term environmental protection at the expense of rather severe short term impacts. In the long term, natural regrowth of vegetation would substantially eliminate any short term impacts.

Engineering Feasibility. The technologies proposed for implementation under Alternative 4-3C are standard engineering and scientific practices that can be executed without project delay. Primary technical concerns include the moisture content of the excavated materials, the load bearing strength of the soils being excavated (will they support construction equipment), sedimentation effects on areas not selected for active remediation, transporation and disposal of Class III materials, development of a solidification/stabilization process, and development of proposed action levels for the environmental monitoring program.

Several excavation techniques are available that can excavate the contaminated materials. A combination of bulldozers, frontend loaders, and dump trucks can be used for excavation. In order to minimize technical problems, excavation

activities should be scheduled for the dry season. This may increase the fugitive dust problem; however, this can be controlled by sprinkling or other dust control measures.

Transportation of contaminated materials to existing landfills would be by truck, which is a proven technology. The loss of contaminated materials would be minimized through the use of liners and covers.

Co-disposal of solidified/stabilized soils in an existing Class III landfill may raise technical concerns over the long term durability of such materials in the Class III environment. Special placement procedures would have to be implemented. Co-disposal may be prohibited by regulatory authorities.

Solidification/stabilization of wastes containing high levels of heavy metals has been demonstrated; however, the process must be developed on a site specific basis. Implementation of a solidification/stabilization technology in California is complicated by the two phase test procedure (TTLC/STLC) and the use of a citric acid extraction that is substituted for the acetic acid extraction of the U.S. EPA's Extraction Procedure. Solidification/stabilization does not remove the metals, and other than for the dilution effects caused by adding large amounts of binder, the TTLC is essentially unchanged. The citric acid extraction is generally believed to be more rigorous than the acetic acid extraction and the data base for successful solidification/stabilization when using a citric acid extraction is limited. Discussions with State of California regulatory personnel (Tornatele 1988) indicated that some success has been demonstrated in reducing the STLC and that special waivers of the TTLC requirement can be obtained when solidification/stabilization is implemented.

The proposed environmental monitoring techniques are standard engineering and scientific practices that can be executed without project delay. Care must be taken to ensure that the sample size for the biological monitoring is sufficient and organized in a way to allow for evaluation of statistical significance. Difficulties may be encountered in the development of proposed action levels; however, these difficulties are not expected to present a major obstacle to execution of this alternative.

Costs. The present worth cost of Alternative 4-3C is estimated to be $263,000.

5.2.4.6 Alternative 4-3D: Excavation/Immobilization/Disposal at Monofill on NWS Concord

Description. The excavation/immobilization/monofill disposal option consists of excavating those areas where soil metal content exceeds the TTLC/STLC criterion, immobilization of the contaminants by addition of chemical reagents, and land disposal in a monofill located on NWS Concord. The excavated materials will be classified into the appropriate categories (Class I, Class II, and Class III). Class I and Class II materials would be treated with chemical reagents to immobilize the contaminants. This process is generally referred to as chemical solidification/stabilization (USEPA 1986a). Typical solidification/stabilization methods include the addition of 25-100 percent by weight of cement, pozzolanic, and/or proprietary materials. It is assumed that this process is capable of immobilizing the contaminants and the materials would be suitable for disposal in a land disposal facility constructed to Class III standards. The major components of this alternative include: excavation of contaminated materials, classification of the contaminated materials, immobilization of contaminants in Class I and Class II wastes, transportation of the contaminated materials to the disposal site, liming of low pH areas, disposal in a monofill constructed on NWS Concord, long term monitoring of the remediation site, and long term monitoring of the monofill. The primary means of transportation assumed for planning purposes is in lined and covered dump trucks with a capacity of approximately 18 cubic yards.

Environmental and Public Health Screening. This alternative could provide for substantial remediation of ecological and health hazards associated with contaminated soils in RASS 4.

Excavation of contaminated material presents the potential for adverse effects caused by exposure of construction personnel and persons located on the NWS Concord to the excavated materials during transport of the materials from the remediation area to the monofill. Impacts on the general public would be

minimized because the contaminants would be immobilized in the soil and the contaminated soils will be disposed of on NWS Concord. Fugitive dust may be a problem; however, this can be minimized through proper planning and design. The excavation of contaminated materials will also impact the resident wild-life populations by death or displacement. Over time, however, the area of excavation will revegetate. These short term impacts would be offset by the potential for long term recovery of the area once the contaminated materials have been removed. Anticipated short term impacts can be minimized by proper planning of construction activities.

Trucks would be used for transporting contaminated soils to the monofill. Additional truck traffic would cause noise pollution and a possible increase in accidents, which could cause loss of life, air pollution, and increased exposure to spilled contaminated materials.

Alternative 4-3D provides long term environmental protection at the expense of rather severe short term impacts. In the long term, natural regrowth of vegetation would substantially eliminate any short term impacts.

Engineering Feasibility. The technologies proposed for implementation under Alternative 4-3D are standard engineering and scientific practices. Primary technical concerns include the moisture content of the excavated materials, the load bearing strength of the soils being excavated (will they support construction equipment), sedimentation effects on areas not selected for active remediation, transporation and disposal of Class III materials, development of a solidification/ stabilization process, and construction of a monofill, and development of proposed action levels for the environmental monitoring program.

Several excavation techniques are available that can excavate the contaminated materials. A combination of bulldozers, frontend loaders, and dump trucks can be used for excavation. In order to minimize technical problems, excavation activities should be scheduled for the dry season. This may increase the fugitive dust problem; however, this can be controlled by sprinkling or other dust control measures. Sedimentation effects on adjacent areas can be controlled by existing technology.

Transportation of contaminated materials to the monofill would be by truck, which is a proven technology. The loss of contaminated materials would be minimized through the use of liners and covers. In addition, the contaminants would be immobilized in the soil by the solidification/stabilization process.

Disposal of solidified/stabilized soils in a monofill located on NWS Concord may raise technical concerns over the long term durability of such materials. Because of these concerns and the results of the geological investigations conducted by Lutton et al (1987) any monofill constructed on NWS Concord should be designed to meet Class I engineering standards. Use of Class I engineering standards, combined with the relatively limited mobility of metals, would provide long term security for disposal of the solidified/ stabilized materials. None of the available monofill sites meet State of California siting requirements for a Class I disposal facility.

Solidification/stabilization of wastes containing high levels of heavy metals has been demonstrated; however, the process must be developed on a site specific basis. Implementation of a solidification/stabilization technology in California is complicated by the two phase test procedure (TTLC/STLC) and the use of a citric acid extraction that is substituted for the acetic acid extraction of the U.S. EPA's Extraction Procedure. Solidification/ stabilization does not remove the metals, and other than for the dilution effects caused by adding large amounts of binder, the TTLC is essentially unchanged. The citric acid extraction is generally believed to be more rigorous than the acetic acid extraction and the data base for successful solidification/stabilization when using a citric acid extraction is limited. Discussions with State of California regulatory personnel (Tornatele 1988) indicated that some success has been demonstrated in reducing the STLC and that special waivers of the TTLC requirement can be obtained when solidification/stabilization is implemented.

The proposed environmental monitoring techniques are standard engineering and scientific practices that can be executed without project delay. Care must be taken to ensure that the sample size for the biological monitoring is sufficient and organized in a way to allow for evaluation of statistical significance. Difficulties may be encountered in the development of proposed action

levels; however, these difficulties are not expected to present a major obstacle to execution of this alternative.

Costs. The present worth cost of Alternative 4-3D is estimated to be $1,241,000.

5.2.4.7 Alternative 4-3E: Excavation/Soil Washing/Disposal at Existing Landfills

Description. This alternative consists of excavation of the soils in those areas where soil metal content exceeds the TTLC/STLC criterion and removal of the contamination by chemical washing (Nash and Traver 1986). The washed soils would be transported to an existing Class III land disposal facility. The soil washing would be accomplished by pumping an aqueous solution of acids, bases, surfactants, chelating agents, or any combination thereof, through a series of three upflow soil column reactors. The contaminated washing solutions would be treated for recycling of the washing agents. The resulting waste sludges would be treated and transported to an existing Class I disposal facility. Major components of this alternative include: excavation, soil washing, transportation of treated soils and sludges to existing disposal facilities of the appropriate class, disposal of the materials in an appropriate class of landfill, liming of low pH areas, and long term monitoring of the remediation area.

Environmental and Public Health Screening. This alternative provides for substantial remediation of ecological and health hazards associated with contaminated soils in RASS 4.

Excavation of contaminated material presents the potential for adverse effects caused by exposure of construction personnel and the general public to the excavated materials during transport of the materials to existing disposal facilities. Impacts on the general public from the contaminated soils will be minimized because the contaminants would be removed by the soil washing process. An effluent stream of contaminated sludges would be generated that would require transport to a Class I land disposal facility. The amount of sludge is estimated to be twenty percent of the volume of treated soil.

Fugitive dust may be a problem; however, this can be minimized through proper planning and design. The excavation of contaminated materials will impact the resident wildlife populations in RASS 4 by death or displacement. Over time, however, the area of excavation would revegetate. These short term impacts would be offset by the potential for long term recovery of the area once the contaminated materials have been removed. Anticipated short term impacts can be minimized by proper planning of construction activities.

Trucks would be used to transport treated soils to an existing land disposal facilities. Either truck or rail would be used to transport residual sludges to Class I disposal facilities. Disposal of contaminated sludges in existing landfills has the additional risk of exposing the general public to contaminated materials during transport of these materials to the disposal facilities. Although the trucks would be lined and covered, passage of the trucks through towns and communities would raise community concerns. Additional truck traffic would cause noise pollution and a possible increase in accidents, which could cause loss of life, air pollution, and increased exposure to spilled contaminated materials. Since the soil washing removes and concentrates contaminants, the potential exposure to contaminated materials should be minimized.

Alternative 4-3E provides long term environmental protection at the expense of significant short term impacts. In the long term, natural regrowth of vegetation would substantially eliminate any short term impacts.

Engineering Feasibility. Except for the soil washing technology, the technologies proposed for implementation under Alternative 4-3E are standard engineering and scientific practices. The overriding technical concern associated with this alternative is development of a soil washing process. Other technical concerns include the moisture content of the excavated materials, the load bearing strength of the soils being excavated (will they support construction equipment), sedimentation effects on areas not selected for active remediation, transportation and disposal of Class III materials, transportation and disposal of Class I materials, and development of proposed action levels for the environmental monitoring program.

Several excavation techniques are available that can be used to excavate the contaminated materials. A combination of bulldozers, frontend loaders, and dump trucks can be used for excavation. In order to minimize technical problems, excavation activities should be scheduled for the dry season. This may increase the fugitive dust problem; however, this can be controlled by sprinkling or other dust control measures. Sedimentation effects on adjacent areas can be controlled by existing technology such as silt barriers or silt screens.

Although it is expected that the cleaned soils will be suitable for unrestricted use, for cost estimating purposes, it is assumed that the materials will be disposed of in a Class III landfill. Transportation of decontaminated materials to existing landfills would be by truck, which is a proven technology. The loss of materials will be minimized through the use of liners and covers. Since it is expected that the decontaminated soils will be suitable for unrestricted use, materials loss would not be a critical technical issue. The sludge produced by the soil washing process would be transported to an existing Class I facility by truck or rail. Both truck and rail transportation of contaminated soils are proven technologies. The loss of contaminated materials will be minimized through the use of liners and covers.

Although demonstrated to some degree in the mining and ore processing industry, soil washing for removal of arsenic and heavy metals from contaminated soils has not been proven in a large scale remedial action. The process is developmental and would require additional laboratory and pilot scale study before implementation on a scale of the proposed remedial action for RASS 4. Personnel communications (Tetra Resources 1988, Environmental Field Services 1988, OH Materials 1987, USEPA 1987) indicates conflicting opinions on the technical feasibility of soil washing. If the soil washing process proves to be technically feasible, two waste streams are produced: the decontaminated soils and a sludge containing the heavy metals removed from the soil. It is assumed that the soil will be cleaned sufficiently for unrestricted use; however, the sludge containing the heavy metals will be a Class I and possibly a RCRA waste.

The proposed environmental monitoring techniques are standard engineering and scientific practices that can be executed without project delay. Care must be taken to ensure that the sample size for the biological monitoring is sufficient and organized in a way to allow for evaluation of statistical significance. Difficulties may be encountered in the development of proposed action levels; however, these difficulties are not expected to present a major obstacle to execution of this alternative.

Costs. The present worth cost of Alternative 4-3E is estimated to be $661,000.

5.2.4.8 Alternative 4-3F: Excavation/Soil Washing/Disposal at Monofill on NWS Concord

Description. This alternative consists of excavation of the soils in those areas where soil metal content exceeds the TTLC/STLC criterion and removal of the contamination by chemical washing (Nash and Traver 1986). The washed soils would be transported to a monofill on NWS Concord constructed to Class III standards. The soil washing would be accomplished by pumping an aqueous solution of acids, bases, surfactants, chelating agents, or any combination thereof, through a series of three upflow soil column reactors. The contaminated washing solutions would be treated for recycling of the washing agents. The resulting waste sludges would be treated and transported to an existing Class I disposal facility. Major components of this alternative include: large scale pilot study, excavation, soil washing, transportation of treated soils to a Class III monofill constructed on NWS Concord, transport of sludges to an existing Class I disposal facility, disposal of the materials in the appropriate class of landfill, liming of low pH areas, long term monitoring of the monofill, and long term monitoring of the remediation area.

Environmental and Public Health Screening. This alternative provides substantial remediation of ecological and health hazards associated with contaminated soils in RASS 4.

Alternative 4-3F presents the potential for adverse effects caused by exposure of construction personnel and persons located on NWS Concord to the excavated

materials during transport of the materials from the site of excavation to the monofill. Impacts on the general public from the contaminated soils would be minimized because the contaminants would be removed by the soil washing process and the cleaned soil would be disposed of on the NWS Concord. An effluent stream of contaminated sludges would be generated that would require transport to a Class I land disposal facility. The quality of sludge is estimated to be twenty percent of the volume of treated soils. Fugitive dust may be a problem; however, this can be minimized through proper planning and design.

The excavation of contaminated materials will also impact resident wildlife populations by death or displacement. Over time, however, the area of excavation would recover. These short term impacts would be mitigated by the potential for long term recovery of the area once the contaminated materials have been removed. Anticipated short term impacts can be minimized by proper planning of construction activities.

Trucks would be used for transporting treated soils to the monofill. The disposal of decontaminated soils on NWS Concord reduces the risk of exposing the general public to contaminated materials during remediation activities. Sludges generated by the soil washing process would be transported by truck or rail to an existing Class I disposal facility. Although trucks and rail cars would be lined and covered, passage through NWS Concord and surrounding towns and communities would raise community concerns. Additional truck traffic would cause noise pollution and a possible increase in accidents, which could cause loss of life, air pollution, and increased exposure to spilled contaminated materials. Since the decontaminated soils would be disposed of on NWS Concord, the transportation of Class I materials would be minimized.

Alternative 4-3F provides long term environmental protection at the expense of rather severe short term impacts. In the long term, natural regrowth of vegetation would substantially eliminate any short term impacts.

Engineering Feasibility. Except for the soil washing technology, the technologies proposed for implementation under Alternative 4-3F are standard engineering and scientific practices. The overriding technical concern

associated with this alternative is development of a soil washing process. Other technical concerns include the moisture content of the excavated materials, the load bearing strength of the soils being excavated (will they support construction equipment), sedimentation effects on areas not selected for active remediation, transportation and disposal of Class III materials, transportation and disposal of Class I materials, and development of proposed action levels for the environmental monitoring program.

Several excavation techniques are available that can be used to excavate the contaminated materials. A combination of bulldozers, frontend loaders, and dump trucks can be used for excavation. In order to minimize technical problems, excavation activities should be scheduled for the dry season. This may increase the fugitive dust problem; however, this can be controlled by sprinkling or other dust control measures. Excavation during the day season will also minimize the potential problem of free liquids in the contaminated soils.

Although it is expected that the cleaned soils will be suitable for unrestricted use, for cost estimating purposes, it is assumed that the materials will be disposed of in a Class III landfill. Transportation of decontaminated materials to the monofill would be by truck, which is a proven technology. The loss of materials will be minimized through the use of liners and covers. Since it is expected that the decontaminated soils will be suitable for unrestricted use, materials loss would not be a critical technical issue. The sludge produced by the soil washing process would be transported to an existing Class I facility by truck or rail. Both truck and rail transportation of contaminated soils are proven technologies. The loss of contaminated materials will be minimized through the use of liners and covers.

Although demonstrated to some degree in the mining and ore processing industry, soil washing for removal of arsenic and heavy metals from contaminated soils has not been proven in a large scale remedial action. The process is developmental and would require additional laboratory and pilot scale study before implementation on a scale of the proposed remedial action for RASS 1. Personnel communications (Tetra Resources 1988, Environmental Field Services 1988, OH Materials 1987, USEPA 1987) indicates conflicting

opinions on the technical feasibility of soil washing. If the soil washing process proves to be technically feasible, two waste streams are produced: the decontaminated soils and a sludge containing the heavy metals removed from the soil. It is assumed that the soil will be cleaned sufficiently for unrestricted use; however, the sludge containing the heavy metals will be a Class I and possibly a RCRA waste.

The proposed environmental monitoring techniques are standard engineering and scientific practices that can be executed without project delay. Care must be taken to ensure that the sample size for the biological monitoring is sufficient and organized in a way to allow for evaluation of statistical significance. Difficulties may be encountered in the development of proposed action levels; however, these difficulties are not expected to present a major obstacle to execution of this alternative.

Costs. The present worth cost of Alternative 4-3F is estimated to be $1,602,000.

5.2.4.9 Alternative 4-4A: Capping with Soil Cover

Description. This alternative examines the use of a soil/vegetative cover to reduce the possibility of erosion and direct contact with the contaminated soil materials. The contaminated soil materials located in RASS 4 would not be removed. The primary components of this alternative include: site preparation, placement of a soil cover, grading, revegetation of the cover, and long term monitoring of the remediation area.

Environmental and Public Health Screening. This alternative will substantially eliminate the potential for exposure of biota or humans through direct contact with the highly contaminated surficial soils, and it would prevent redistribution of the contaminated soils into adjacent uncontaminated or slightly contaminated areas. Prevention of biotic contact with the contaminated soils would prevent food chain transfer of the contaminants to humans and reduce or eliminate potential health effects of concern.

The implementation of the soil cap would prevent further migration of contaminants into adjacent areas. The top soil cover would raise the ground elevation a minimum of 4 ft.

Engineering Feasibility. The technologies proposed for implementation under Alternative 4-4A are standard engineering and scientific practices. Technical concerns include the load bearing strength of the soils on which the cap would be constructed, sedimentation effects on areas not selected for active remediation, and development of proposed action levels for the environmental monitoring program.

Construction of the soil cap will be similar to a filling operation, which is a proven technology. Adequate geotechnical design procedures are available to ensure that the cap is durable and performs its intended purpose. Soil caps have been demonstrated for application in an environment similar to RASS 4. Because of the irregular nature of the contaminated areas requiring remediation, there is some question regarding the engineering feasibility of constructing the cap. Erosion of the cap may occur. Sedimentation effects on adjacent areas can be controlled by existing technology.

The proposed environmental monitoring techniques are standard engineering and scientific practices that can be executed without project delay. Care must be taken to ensure that the sample size for the biological monitoring is sufficient to develop a statistically significant data base. Difficulties may be encountered in the development of proposed action levels; however, these difficulties are not expected to present a major obstacle to execution of this alternative.

Costs. The present worth cost of Alternative 4-4A is estimated to be $192,000.

5.2.4.10 Alternative 4-4B: Source Isolation/RCRA Cap

Description. This alternative examines the use of a multilayered cover (RCRA cap) to reduce the possibility of erosion and direct contact with the contaminated soil material. The contaminated soil materials located in RASS 4 would

not be removed. The primary components of this alternative include: site preparation, placement of a cover meeting RCRA requirements, grading, and revegetation of the cover. At a minimum, the RCRA cap would include a 2 ft thick low permeability (10^{-7}) soil layer, a 12 in. drainage layer, a 20 mil synthetic membrane with bedding, and a 2 ft layer of topsoil. Finally, the cover would be graded and revegetated. A cross-section of the proposed RCRA cap is illustrated in Plate 5.3.

Environmental and Public Health Screening. This alternative will substantially eliminate the potential for exposure of biota or humans through direct contact with the highly contaminated surficial soils, and it would prevent redistribution of the contaminated soils into adjacent uncontaminated or slightly contaminated areas. Prevention of biotic contact with the contaminated soils would prevent food chain transfer of the contaminants to humans and reduce or eliminate potential health effects of concern. Implementation of the RCRA cap alternative would also prevent the transport of contamination into the underlying groundwater.

Engineering Feasibility. The technologies proposed for implementation under Alternative 4-4B are standard engineering and scientific practices. Technical concerns include the load bearing strength of the soils on which the cap would be constructed (will they support the cap without excessive long term maintenance), sedimentation effects on areas not selected for active remediation, and development of proposed action levels for the environmental monitoring program.

Construction of the RCRA cap will be similar to a filling operation, which is a proven technology. Adequate geotechnical design procedures are available to ensure that the cap is durable and performs its intended purpose. Sedimentation effects on adjacent areas can be controlled by existing technology.

The proposed environmental monitoring techniques are standard engineering and scientific practices that can be executed without project delay. Care must be taken to ensure that the sample size for the biological monitoring is sufficient and organized in a way to allow for evaluation of statistical significance. Difficulties may be encountered in the development of proposed action

levels; however, these difficulties are not expected to present a major obstacle to execution of this alternative.

Costs. The present worth of Alternative 4-4B is estimated to be $277,000.

5.2.4.11 Alternative 4-6A: In Situ Stabilization

Description. The in situ stabilization alternative consists of injecting the in place contaminated soils with chemical reagents to immobilize the contaminants in the soil. The process is similar to the excavation/immobilization alternatives (Alternative 4-3C and 4-3D), except that the binder chemicals are mixed with the inplace soils and the contaminated soils are not excavated. The major components of this alternative include: development of a solidification/stabilization process, stripping of vegetation, application of the solidification/stabilization binder, revegetation, periodic reapplication of the binder, and long term environmental monitoring of the remediation area.

Environmental and Public Health Screening. This alternative provides limited remediation of the ecological and health hazards associated with the contaminated soils in RASS 4. The primary mechanism of the in situ stabilization process is to reduce the solubility of the metals and thereby reduce their bioavailability. The in situ immobilization process does not remove the metals from the soils. Metals would be available to migrate with any soil or sediment that is physically moved by hydrologic processes. Because of the dynamic hydrologic environment of RASS 4, it is probable that continued migration of contaminants would occur.

Since the metals would remain in the soil, the potential for direct contact would remain. In situ stabilization would reduce the availability of the contaminants for bio-uptake.

Because physical migration would be likely, mere chemical stabilization of the soils would not be totally effective in reducing contaminant migration. The soils could be physically stabilized by adding sufficient binder materials; however, addition of binder materials in the quantities required for physical

stabilization would most probably have environmental consequences similar to the capping alternatives.

In situ stabilization requires periodic reapplication of binder materials. It is estimated that reapplication of binder materials would be necessary every five to ten years. Reapplication would involve similar activities to the initial application. Because of the maintenance requirements, adverse impacts of the in situ stabilization alternative would be long term and continuing. This alternative would have severe short term impacts as well as major long term adverse impacts.

Engineering Feasibility Evaluation. Primary technical concerns include the ability to apply binder materials in wetlands, the load bearing strength of the soils (will they support construction equipment), sedimentation effects on areas not selected for active remediation, development of a solidification/stabilization process that can be applied in situ in the wetlands. Difficulties may also be encountered in the development of proposed action levels.

The primary technology, in situ stabilization, proposed for implementation in this alternative has not been demonstrated on a large scale, nor have they been applied in a wetland environment. Although the technology is similar to solidification/stabilization technology used in the excavation/immobilization alternatives, the excavation alternatives have the advantage that the materials are removed from an active hydrologic environment and the solidification/stabilization processing is accomplished in a controlled environment. Of particular technical concern to this alternative is the long term durability of the treated soils in an active hydrologic environment. Since the in situ stabilization process is oriented towards the chemical immobilization of contaminants, it is likely that physical mobilization will continue.

Solidification/stabilization of wastes, containing high levels of heavy metals has been demonstrated; however, the process must be developed on a site specific basis. In situ stabilization in a wetland environment has not been demonstrated. Implementation of a solidification/stabilization technology in

California is complicated by the two phase test procedure (TTLC/STLC) and the use of a citric acid extraction that is substituted for the acetic acid extraction of the U.S. EPA's Extraction Procedure. Solidification/ stabilization does not remove the metals, and other than the dilution effects caused by adding large amounts of binder, the TTLC is essentially unchanged. The citric acid extraction is generally believed to be more rigorous than the acetic acid extraction and the data base for successful solidification/ stabilization when using a citric acid extraction is limited. Discussions with State of California regulatory personnel (Tornatele 1988) indicated that some success has been demonstrated in reducing the STLC and that special waivers of the TTLC requirement can be obtained when solidification/ stabilization is implemented. These potential technical problems are compounded in this alternative because the alternative leaves the treated materials in an active environment rather than placing them in a controlled landfill environment. Sedimentation effects on adjacent areas can be controlled by existing technology.

The proposed environmental monitoring techniques are standard engineering and scientific practices that can be executed without project delay. Care must be taken to ensure that the sample size for the biological monitoring is sufficient and organized in a way to allow for evaluation of statistical significance. Difficulties may be encountered in the development of proposed action levels; however, these difficulties are not expected to present a major obstacle to execution of this alternative.

Overall, because of site specific reasons, the engineering feasibility of this alternatives is low. Since a portion of RASS 4 contains low pH materials, in situ stabilization can be used to address this problem, thereby reducing the area of materials requiring excavation and disposal.

Costs. The present worth costs of Alternative 4-6A is estimated to be $342,000.

5.2.4.12 Alternative 4-6B: Soil Flushing

Description. The soil flushing alternative consists of injecting a soil washing solution to dislodge, solubilize, or other wise remove the contaminants form the soils. Chemically, the soil flushing alternative is similar to the soil washing alternatives (Alternative 4-3E and 4-3F). Possible flushing agents include water, acids, bases, chelating agents, and/or surfactants. The major components of this alternative include: development of a soil washing process that is effective for the contaminants found on RASS 4, construction of a flushing agent application and recovery system, application and recovery of the soil flushing agents, treatment of the recovered soil flushing agents, disposal of residual sludges and flushing agents, and environmental monitoring of the remediation area.

Environmental and Public Health Screening. This alternative provides substantial remediation of ecological and health hazards associated with the contaminated soils in RASS 4.

The soil flushing process produces an effluent stream of sludges that will be classified as Class I and possibly RCRA wastes. The amount of sludge would be similar to that produced in the soil washing alternatives and is estimated to be approximately 20 percent of the treated soils. The residual sludges would be transported to an existing Class I landfill for disposal. Lined and covered trucks or rail cars would be the primary means of transport. Transport of these materials has the additional risk of exposure of the general public to contaminated materials. Passage of the trucks and rail cars through populated areas may raise community concerns. Additional traffic would cause noise pollution, and a possible increase in accidents, which could cause loss of life, air pollution, and increased exposure to contaminated materials.

The construction of soil flushing reagent application and recovery system would cause severe short term disruption of the habitat in RASS 4. Anticipated short term impacts could be minimized by proper planning of construction activities; however, since the application and recovery of the soil flushing

reagents may take several seasons, short term impacts may occur for a substantial period of time.

In addition to the disruption caused by construction activities, some soil flushing reagents may be toxic or hazardous. Since 100 percent recovery of the soil flushing reagents is unlikely, soil flushing may have a detrimental impact on the plant and wildlife in RASS 4.

Alternative 4-6B provides long term environmental protection at the expense of significant short term impacts.

Engineering Feasibility. Soil flushing technology is not considered to be a standard engineering or scientific technology for remediation of contaminated sites. The overriding technical concern associated with this alternative is development of a soil flushing process. Other technical concerns include the load bearing strength of the soils (will they support construction equipment), the permeability of the soils (can the flushing agents be recovered), sedimentation effects on areas not selected for active remediation, transportation and disposal of Class I materials, and development of proposed action levels for the environmental monitoring program.

The chemistry of soil flushing is similar to that of soil washing. The process is developmental and would require additional laboratory and pilot scale study before implementation on a scale of the proposed remedial action for RASS 2. If the soil flushing process proves to be technically feasible, a sludge containing the heavy metals removed from the soil would require disposal. It is assumed that the soil will be cleaned sufficiently for unrestricted use; however, the sludge containing the heavy metals will be a Class I and possibly a RCRA waste.

Construction of a flushing agent application and recovery system in the wetland environment will be technically difficult. Although construction could be scheduled for the dry season, the low permeability of the soils would necessitate construction of recovery wells or underdrains at a close interval, thus increasing the cost and making complete recovery of the

flushing agents difficult. This may be particularly important since come of the reagents used for soil flushing are hazardous materials.

The proposed environmental monitoring techniques are standard engineering and scientific practices that can be executed without project delay. Care must be taken to ensure that the sample size for the biological monitoring is sufficient and organized in a way to allow for evaluation of statistical significance. Difficulties may be encountered in the development of proposed action levels; however, difficulties are not expected to present a major obstacle to execution of this alternative.

Because neither soil washing or soil flushing technology has been demonstrated on a large scale, the engineering feasibility of the soil flushing alternative is considered to be low.

Costs. The present worth cost of Alternative 4-6B is estimated to be $635,000.

5.3 Selection of Alternatives for Detailed Analysis

The environmental and public health impacts discussed in the previous sections are summarized in Table 5.2. This table rates the positive and negative impacts of each alternative. If the implementation of an alternative results in the improvement/remediation of the existing conditions, the alternative is considered to have a positive impact. On the other hand, if an alternative adversely impacts or deteriorates the existing conditions, the alternative is considered to have a negative impact. The positive and negative impacts have been rated as major, moderate, minor, and none. For a positive impact, a rating of major means that the alternative exceeds the intended criteria/purpose most of the time; a moderate rating means that the alternative promotes the criteria but may not attain the intended objectives all of the time; a minor rating means that the alternative does not promote the criteria; and a none rating means that the alternative has no impact on the existing conditions at the site or that the existing conditions continue. Similarly, the negative impacts have been rated as severe, major, moderate, minor, and none. A severe negative impact means that the implementation of the

Table 5.2

Summary of Environmental and Public Health Screening

Potential Remedial Alternative	Positive Impacts		Negative Impacts	
	Environmental	Public Health	Environmental	Public Health
RASS 1				
Alternative 1-1	None	None	Major	Major
Alternative 1-2	Minor	Minor	Major	Major
Alternative 1-3A	Major	Major	Major	Minor
Alternative 1-3B	Major	Major	Major	Minor
Alternative 1-3C	Major	Major	Major	Minor
Alternative 1-3D	Major	Major	Major	Minor
Alternative 1-3E	Major	Major	Major	Minor
Alternative 1-3F	Major	Major	Major	Minor
Alternative 1-4A	Moderate	Moderate	Severe	Minor
Alternative 1-4B	Moderate	Moderate	Severe	Minor
Alternative 1-5A	Major	Major	Minor	Minor
Alternative 1-5B	Major	Major	Moderate	Minor
Alternative 1-6A	Moderate	Moderate	Severe	Minor
Alternative 1-6B	Moderate	Moderate	Moderate	Minor
RASS 2				
Alternative 2-1	None	None	Major	Major
Alternative 2-2	Minor	Minor	Major	Major
Alternative 2-3A	Major	Major	Major	Minor
Alternative 2-3B	Major	Major	Major	Minor
Alternative 2-3C	Major	Major	Major	Minor
Alternative 2-3D	Major	Major	Major	Minor
Alternative 2-3E	Major	Major	Major	Minor
Alternative 2-3F	Major	Major	Major	Minor
Alternative 2-4A	Moderate	Moderate	Severe	Minor
Alternative 2-4B	Moderate	Moderate	Severe	Minor
Alternative 2-5A	Major	Major	Minor	Minor
Alternative 2-5B	Major	Major	Moderate	Minor
Alternative 2-6A	Moderate	Moderate	Severe	Minor
Alternative 2-6A	Moderate	Moderate	Moderate	Minor
RASS 3				
Alternative 3-1	None	None	Major	Major
Alternative 3-2	Minor	Minor	Major	Major
Alternative 3-3A	Major	Major	Major	Minor
Alternative 3-3B	Major	Major	Major	Minor
Alternative 3-3C	Major	Major	Major	Minor
Alternative 3-3D	Major	Major	Major	Minor
Alternative 3-3E	Major	Major	Major	Minor
Alternative 3-3F	Major	Major	Major	Minor

(Continued)

Table 5.2 (Concluded)

Potential Remedial Alternative	Positive Impacts		Negative Impacts	
	Environmental	Public Health	Environmental	Public Health
Alternative 3-4A	Moderate	Moderate	Severe	Minor
Alternative 3-4B	Moderate	Moderate	Severe	Minor
Alternative 3-6A	Moderate	Moderate	Severe	Minor
Alternative 3-6B	Moderate	Moderate	Moderate	Minor
RASS 4				
Alternative 4-1	None	None	Moderate	Moderate
Alternative 4-2	Minor	Minor	Moderate	Moderate
Alternative 4-3A	Major	Moderate	Minor	Minor
Alternative 4-3B	Major	Moderate	Minor	Minor
Alternative 4-3C	Major	Moderate	Minor	Minor
Alternative 4-3D	Major	Moderate	Minor	Minor
Alternative 4-3E	Major	Moderate	Minor	Minor
Alternative 4-3F	Major	Moderate	Minor	Minor
Alternative 4-4A	Moderate	Moderate	Minor	Minor
Alternative 4-4B	Moderate	Moderate	Minor	Minor
Alternative 4-6A	Moderate	Moderate	Minor	Minor
Alternative 4-6B	Moderate	Moderate	Minor	Minor

alternative will be highly detrimental to the environment and very difficult to mitigate. A rating of major will mean extensive adverse impact on the environment; a moderate rating means that the alternative will have adverse impacts which may not be extensive; a minor rating signifies adverse impacts that are of little or no significance; and a none rating means that implementation of the alternative does not impact the existing conditions.

The results of the engineering feasibility and cost screening are presented in Table 5.3.

The engineering feasibility of each alternative is rated in terms of high, moderate, and low. A high rating indicates that the technologies have been demonstrated on a field scale and there is a high probability of successful implementation. For example, excavation and landfilling of soils contaminated with heavy metals is a technology that has been demonstrated on a large scale. A moderate rating indicates that the technologies have not been implemented on a field scale in a setting similar to those found in RASS's 1, 2, 3, or 4 on

Table 5.3

Summary of Engineering Feasibility and Cost Screening

Potential Remedial Alternative	Engineering Feasibility	Cost Range (000$) Low	High
RASS 1			
Alternative 1-1	High	63	104
Alternative 1-2	High	2,598	4,330
Alternative 1-3A	High	3,542	5,903
Alternative 1-3B	Low	3,075	5,125
Alternative 1-3C	Moderate	2,517	4,194
Alternative 1-3D	Moderate	3,675	6,125
Alternative 1-3E	Moderate	4,819	8,032
Alternative 1-3F	Moderate	5,497	9,162
Alternative 1-4A	High	2,100	3,500
Alternative 1-4B	Moderate	2,925	4,875
Alternative 1-5A	High	3,573	5,904
Alternative 1-5B	High	2,327	3,878
Alternative 1-6A	Low	2,946	4,909
Alternative 1-6B	Low	4,316	7,193
RASS 2			
Alternative 2-1	High	42	70
Alternative 2-2	High	765	1,274
Alternative 2-3A	High	2,360	3,933
Alternative 2-3B	Low	2,252	3,753
Alternative 2-3C	Moderate	1,642	2,737
Alternative 2-3D	Moderate	2,643	4,405
Alternative 2-3E	Moderate	3,150	5,249
Alternative 2-3F	Moderate	3,837	6,395
Alternative 2-4A	High	1,044	1,739
Alternative 2-4B	High	1,463	2,438
Alternative 2-5A	High	2,412	4,020
Alternative 2-5B	High	1,187	1,979
Alternative 2-6A	Low	1,950	3,249
Alternative 2-6B	Low	2,804	4,673
RASS 3			
Alternative 3-1	High	117	194
Alternative 3-2	High	1,110	1,849
Alternative 3-3A	High	2,233	3,722
Alternative 3-3B	Low	2,259	3,765
Alternative 3-3C	Moderate	1,657	2,762
Alternative 3-3D	Moderate	2,680	4,4[illegible]7
Alternative 3-3E	Moderate	3,277	5,462

(Continued)

Table 5.3 (Concluded)

Potential Remedial Alternative	Engineering Feasibility	Cost Range (000$)	
		Low	High
Alternative 3-3F	Moderate	3,964	6,607
Alternative 3-4A	Low	1,611	2,684
Alternative 3-4B	Low	2,285	3,808
Alternative 3-6A	Low	1,964	3,273
Alternative 3-6B	Low	2,957	4,927
RASS 4			
Alternative 4-1	High	40	67
Alternative 4-2	High	406	677
Alternative 4-3A	High	199	332
Alternative 4-3B	Low	856	1,422
Alternative 4-3C	Moderate	198	329
Alternative 4-3D	Moderate	931	1,552
Alternative 4-3E	Moderate	496	827
Alternative 4-3F	Moderate	1,202	2,003
Alternative 4-4A	High	144	240
Alternative 4-4B	High	208	347
Alternative 4-6A	Low	257	428
Alternative 4-6B	Low	477	794

NWS Concord; however, it is believed that with further study and design implementation of the alternative would probably be successful. For example, solidification/stabilization has not been applied in the specific environmental setting found on NWS Concord; however, it is a technology that has been used successfully on a large scale for treating hazardous other wastes. A low rating indicates that either the technologies used in the alternative are primarily conceptual in nature and would require significant amounts of additional development before they are ready for field application or, that the technologies are not suited for application in the specific environment of the individual RASS. For example, soil flushing has not been demonstrated on the field scale and would require significant additional process development and pilot scale studies prior to field implementation.

The summary of cost screening is also presented in Table 5.3. The costs presented in Table 5.3 are based on the cost data developed in Cullinane et al. (1986). Because of the nature of cost screening, the cost presented is the ±25 percent range from the screening level cost estimate. It should be

noted that there is considerable uncertainty in the cost for alternatives incorporating the more innovative technologies such as soil washing and soil flushing. There is essentially no track record for judging the accuracy of these costs. On the other hand, costs for alternatives incorporating the more traditional technologies such as excavation and landfilling should be more accurate. No alternatives were eliminated from detailed evaluation because of cost.

A review of the preceding sections and Tables 5.2 and 5.3 results in the selection of the following alternatives for detailed analysis.

5.3.1 Alternatives Selected for RASS 1

In RASS 1, the two capping alternatives (1-4A and 1-4B) are considered to have severe negative environmental impacts and are removed from further consideration for application in RASS 1. The excavation alternatives (1-3A through 1-3F) are considered to have the potential for major short term impacts and would require mitigation. These impacts can be largely overcome by the implementation of the restoration options found in alternatives 1-5A. Since restoration will be required, alternative 1-5A is dropped from consideration as a separate alternative and the restoration element is added to each of the excavation alternatives (Alternative 1-3A through 1-3F).

Extensive field investigations conducted by the WES (Lutton et al 1987) indicated that there are no landfill sites located on NWS Concord meeting State of California siting requirements for a Class I land disposal facility. Accordingly, Alternative 1-3B was not carried forward for detailed evaluation. The no action alternative (1-1) is carried forward as required by the NCP. The increased monitoring alternative (1-2) is carried forward for detailed analysis as an element of the active remedial action alternatives. Alternatives 1-3C through 1-3F are carried forward for detailed analysis as alternatives that provide for permanent treatment of the contaminated materials as required by CERCLA, as amended. Because of concerns over the long term durability of solidified/stabilized soils, Alternative 1-3D was modified to include construction of the monofill on NWS Concord to Class I engineering

standards. It should be noted that no sites on NWS Concord meet Class I siting requirements.

Alternative 1-6A was deleted from further consideration because of concerns over the engineering feasibility and the continued environmental impacts associated with required maintenance activities. Since the in situ stabilization would require both physical and chemical stabilization of the in place soils, there would be both significant initial environmental impacts and continuous impacts as the chemicals used for stabilizing the contaminants are periodically applied during the life of the remedial action.

Alternative 1-6B was deleted from further evaluation because of concerns over the engineering feasibility of the soil flushing alternative. Low permeability of soils, shallow contamination, and the areal extent of the contamination make the engineering feasibility of this alternative doubtful. Further difficulties are also anticipated in the recovery of soil flushing chemicals, some of which may be toxic or hazardous.

No alternatives were deleted from detailed evaluation because of costs. The cost of all alternatives providing positive remediation of contamination were within the general accuracy of the screening level cost estimating methodology. The final list of alternatives for RASS 1 selected for detailed evaluation include:

a. Alternative 1-1: No Action
b. Alternative 1-2: Environmental Monitoring
c. Alternative 1-3A: Excavation/Disposal at Existing Landfills/Restoration
d. Alternative 1-3C: Excavation/Immobilization/Disposal at Existing Landfills/Restoration
e. Alternative 1-3D: Excavation/Immobilization/Disposal at Monofill on NWS Concord/Restoration
f. Alternative 1-3E: Excavation/Soil Washing/Disposal at Existing Landfills/Restoration
g. Alternative 1-3F: Excavation/Soil Washing/Disposal at Monofill on NWS Concord/Restoration

5.3.2 Alternatives Selected for RASS 2

In RASS 2, the two capping alternatives (2-4A and 2-4B) are considered to have severe negative environmental impacts and are removed from further consideration for application in RASS 2. The excavation alternatives (2-3A through 2-3F) are considered to have the potential for major short term impacts and would require mitigation. These impacts can be largely overcome by the implementation of the restoration options found in Alternative 2-5A. Since restoration will be required, Alternative 2-5A is dropped from consideration as a separate alternative and the restoration element is added to each of the excavation alternatives (Alternatives 2-3A through 2-3F).

Extensive field investigations conducted by the WES (Lutton et al 1987) indicated that there are no landfill sites located on NWS Concord meeting State of California siting requirements for a Class I landfill. Accordingly, Alternative 2-3B was not carried forward for detailed evaluation. The no action alternative (2-1) is carried forward as required by the NCP. The increased monitoring alternative (2-2) is carried forward for detailed analysis as an element of the active remedial action alternatives. Alternatives 2-3C through 2-3F are carried forward for detailed analysis as alternatives that provide for permanent treatment of the contaminated materials as required by CERCLA, as amended. Because of concerns over the long term durability of solidified/stabilized soils, Alternative 2-3D was modified to include construction of the monofill on NWS Concord to Class I engineering standards. It should again be noted that no available site on NWS Concord meets Class I siting requirements.

Alternative 2-6A was deleted from further consideration because of concerns over the engineering feasibility and the continued environmental impacts associated with required maintenance activities. Since the in situ stabilization would require both physical and chemical stabilization of the in place soils, there would be both significant initial environmental impacts and continuous impacts as the chemicals used for stabilizing the contaminants are periodically applied during the life of the remedial action.

Alternative -6B was deleted from further evaluation because of concerns over the engineering feasibility of the soil flushing alternative. Low permeability of soils, shallow contamination, and the areal extent of the contamination make the engineering feasibility of this alternative doubtful. Further difficulties are also anticipated in the recovery of soil flushing chemical, some of which may be toxic or hazardous.

No alternatives were deleted from detailed evaluation because of costs. The cost of all alternatives providing positive remediation of contamination were within the general accuracy of the screening level cost estimating methodology. The final list of alternatives for RASS 2 include:

a. Alternative 2-1: No Action

b. Alternative 2-2: Environmental Monitoring

c. Alternative 2-3A: Excavation/Disposal at Existing Landfills/Restoration

d. Alternative 2-3C: Excavation/Immobilization/Disposal at Existing Landfills/Restoration

e. Alternative 2-3D: Excavation/Immobilization/Disposal at Monofill on NWS Concord/Restoration

f. Alternative 2-3E: Excavation/Soil Washing/Disposal at Existing Landfills/Restoration

g. Alternative 2-3F: Excavation/Soil Washing/Disposal at Monofill on NWS Concord/Restoration

5.3.3 Alternatives Selected for RASS 3

The excavation alternatives (3-3A through 3-3F) are considered to have the potential for major short term impacts; however, these impacts can be largely overcome by the implementation of features designed to enhance the rapid regrowth of vegetation in the riparian drainageway that makes up a large percentage of RASS 3. Extensive field investigations conducted by the WES (Lutton et al 1987) indicated that there are no landfill sites located on NWS Concord meeting State of California siting requirements for a Class I landfill. Accordingly, Alternative 3-3B was not carried forward for detailed evaluation. The no action alternative (3-1) is carried forward as required by the NCP. The increased monitoring alternative (3-2) is carried forward for

detailed analysis as an element of the active remedial action alternatives. Implementation of an active restoration program is not considered necessary for RASS 3. Alternatives 3-3C through 3-3F are carried forward for detailed analysis as alternatives that provide for permanent treatment of the contaminated materials as required by CERCLA, as amended. Because of concerns over the long term durability of solidified/stabilized soils, Alternative 3-3D was modified to include construction of the monofill on NWS Concord to Class I engineering standards. It should again be noted that no available site on NWS Concord meets Class I siting requirements.

Alternatives 3-4A and 3-4B were deleted from further consideration because of concerns over the long term durability of soil or RCRA caps constructed in an area such as found on RASS 3 and the environmental impacts caused by cap construction. Construction of a cap in RASS 3 would impede natural drainage and result in the loss of freshwater wetland. Excavation alternatives were evaluated as being more reliable and the short term impacts of excavation would be mitigated by the natural regrowth of vegetation now present on RASS 3. Excavation alternatives would also improve drainage from upstream properties and maintenance of the freshwater wetland in RASS 3 would provide a sink for the collection of contaminants that may enter from upstream properties in the future, providing some protection to RASS 1, RASS 2, and Suisun Bay located downstream from RASS 3.

Alternative 3-6A was deleted from further consideration because of concerns over the engineering feasibility and the continued environmental impacts associated with required maintenance activities. Since the in situ stabilization would require both physical and chemical stabilization of the in place soils, there would be both a significant initial environmental impacts and continuous impacts as the chemicals used for stabilizing the contaminants are periodically applied during the life of the remedial action.

Alternative 3-6B was deleted from further evaluation because of concerns over the engineering feasibility of the soil flushing alternative. Low permeability of soils, shallow contamination, and the areal extent of permeability of soils, shallow contamination, and the areal extent of the contamination make the engineering feasibility of this alternative doubtful. Further

difficulties are also anticipated in the recovery of soil flushing chemicals, some of which may be toxic or hazardous.

No alternatives were deleted from detailed evaluation because of costs. The cost of all alternatives providing positive remediation of contamination were within the general accuracy of the screening level cost estimating methodology. The final list of alternatives for RASS 3 include:

a. Alternative 3-1: No Action
b. Alternative 3-2: Environmental Monitoring
c. Alternative 3-3A: Excavation/Disposal at Existing Landfills
d. Alternative 3-3C: Excavation/Immobilization/Disposal at Existing Landfills
e. Alternative 3-3D: Excavation/Immobilization/Disposal at Monofill on NWS Concord
f. Alternative 3-3E: Excavation/Soil Washing/Disposal at Existing Landfills
g. Alternative 3-3F: Excavation/Soil Washing/Disposal at Monofill on NWS Concord

5.3.4 Alternatives Selected for RASS 4

The no action alternative (4-1) is carried forward as required by the NCP (USEPA 1984b). The increased monitoring alternative (4-2) is carried forward for detailed analysis as an element of the active remedial action alternatives. The excavation alternatives (4-3A through 4-3F) are considered to have the potential for moderate short term impacts. These impacts can be largely overcome by the implementation of features designed to enhance the rapid regrowth of vegetation. Extensive field investigations conducted by WES (Lutton et al 1987) indicated that there are no landfill sites located on NWS Concord meeting State of California siting requirements for a Class I landfill. Accordingly, Alternative 4-3B was not carried forward for detailed evaluation. Implementation of an active restoration program is not considered necessary for RASS 4. Alternatives 4-3C through 4-3F are carried forward for detailed analysis as alternatives that provide for permanent treatment of the contaminated materials as required by CERCLA, as amended. Because of concerns

over the long term durability of solidified/stabilized soils, Alternative 4-3D was modified to include construction of the monofill to Class I standards. Alternative 4-6A was deleted from further consideration because of concerns over the engineering feasibility of the alternative. Specifically, periodic reapplication of stabilization binder chemicals, unknown long term durability of the in situ stabilization process, and the likelihood that physical migration of the contaminants sorbed to soils may continue. Application of a similar technology as an element of the excavation alternatives, however, will be used to reduce the amount of contaminated soils requiring excavation and disposal.

Alternative 4-6B was deleted from further evaluation because of concerns over the engineering feasibility of the soil flushing alternative. Low permeability of soils, shallow contamination, and the areal extent of the contamination make the engineering feasibility of this alternative doubtful. Further difficulties are also anticipated in the recovery of soil flushing chemicals, some of which may be toxic or hazardous.

No alternatives were deleted from detailed evaluation because of costs. The cost of all alternatives providing positive remediation of contamination were within the general accuracy of the screening level cost estimating methodology. The final list of alternatives for RASS 4 include:

a. Alternative 4-1: No Action
b. Alternative 4-2: Environmental Monitoring
c. Alternative 4-3A: Excavation/Disposal at Existing Landfills
d. Alternative 4-3C: Excavation/Immobilization/Disposal at Existing Landfills
e. Alternative 4-3D: Excavation/Immobilization/Disposal at Monofill on NWS Concord
f. Alternative 4-3E: Excavation/Soil Washing/Disposal at Existing Landfill
g. Alternative 4-3F: Excavation/Soil Washing/Disposal at Monofill on NWS Concord
h. Alternative 4-4A: Source Isolation/Soil Cap
i. Alternative 4-4B: Source Isolation/RCRA Cap

6.0 DETAILED DESCRIPTION OF ALTERNATIVES

The purpose of this section is to provide a description of the 28 remedial action alternatives that were retained for detailed evaluation based on the initial screening process. As indicated in Section 3.0, NWS Concord was divided into four remedial action subsites (RASS) for purposes of evaluation. Alternatives for each RASS selected for detailed evaluation are discussed below.

6.1 Remedial Action Subsite 1

6.1.1 Alternative 1-1. No Action

6.1.1.1 Description. The no action alternative involves no active remediation activities. Soils containing high levels of arsenic and heavy metals (exceeding TTLC/STLC criterion) would be left in the "as is" condition. No environmental monitoring other than the proposed surface water and ground water investigation (US Navy 1987) would be implemented. However, some miscellaneous site activities would be implemented. Contaminated areas would be posted and property inventories would be appropriately annotated. Actual on site work will be limited to posting contaminated areas. Quantities associated with implementation of Alternative 1-1 are presented in Table A.1.

6.1.1.2 Implementation. The major steps in implementing the no action alternative are:

a. Development of a contaminated area notification plan,
b. Posting the contaminated area with appropriate signs,
c. Annotation of property records, and
d. Annual inspection and maintenance of posted areas.

Development of Notification Plan. A detailed plan would be developed to ensure that adequate notification is provided to persons on NWS Concord and the general public concerning the presence of contamination on RASS 1.

Posting of Contaminated Areas. Contaminated areas would be posted with appropriate signs to warn both authorized personnel and potential trespassers of the presence of contamination.

Annotation of Property Records. Property records would be annotated to identify the location of the contaminated areas in RASS 1.

Annual Inspection and Maintenance. An annual inspection of RASS 1 would be conducted. Maintenance of warning signs would be conducted during this annual inspection.

6.1.2 Alternative 1-2. Environmental Monitoring

6.1.2.1 Description. The environmental monitoring alternative features the no action alternative, i.e., no active remedial action measures (except posting of contaminated areas) combined with periodic environmental monitoring. Materials containing high levels of heavy metals and arsenic would be left in place. An environmental monitoring program would be implemented to periodically evaluate the environmental status of RASS 1 and adjacent areas. The monitoring program would be oriented to the analysis of environmental changes caused by the expected continued migration of contaminants from the areas of high arsenic and heavy metal concentrations. The environmental monitoring alternative would implement a program of surveillance and monitoring of soil and sediments, surface water, ground water, and biota on RASS 1. The environmental monitoring program is designed to emphasize either 1) those areas of environmental concern identified during the RI or 2) concerns raised by State regulatory agencies. Monitoring would be conducted in two phases.

Phase 1 sampling emphasizes the collection of data on the characteristics of the soil, and sediments, surface water, and ground water located on RASS 1 and also implements a program of animal and vegetation observation. The Phase 1 sampling program would be conducted annually during the first five years following implementation of this alternative. Assuming no adverse impacts are identified that would necessitate implementation of an active remedy, Phase 1

sampling would be conducted every five years thereafter. This five year increment is consistent with the five year review required by SARA.

Phase 1. Soil and Sediment Sampling. Surface soil samples from the 0 to 12 in. depth would be collected and analyzed for arsenic, cadmium, copper, lead, selenium, and zinc. Sampling locations would correspond as closely as possible to those locations sampled by Lee et al. (1986). Additional samples would be collected over the remainder of the RASS in the most probable direction of contaminant migration. Soil metal concentrations would be compared to that of previous samples, allowing an evaluation of actual and potential contaminant migration and adverse impacts on the public health and the environment. For planning purposes, 30 soil samples will be collected on RASS 1 during each sampling episode.

Phase 1. Surface Water. Surface water samples would be collected at seven locations in the creeks and slough located to the west of RASS 1. Water samples would be collected following a period of rainfall. Each sample would be analyzed for total and dissolved arsenic, cadmium, copper, lead, selenium, and zinc to evaluate the mobility of both bound and soluble metals.

Phase 1. Ground Water. Ground water samples would be collected from six monitoring wells. Samples would be analyzed for both total and dissolved arsenic, cadmium, copper, lead, selenium, and zinc.

Phase 1. Wildlife Observation. Observation of wildlife would be conducted once annually. Permanent transects would be established.

Phase 1. Vegetation Observation. Observations of vegetation would be conducted twice annually. Permanent transects would be established.

Phase 1. Site Conditions. Observations of general site conditions would be conducted.

Phase 2 sampling is oriented towards the evaluation of animal and plant populations on the RASS. Phase 2 monitoring for RASS 1 includes: earthworm

bioaccumulation studies, small mammal bioaccumulation studies, macroinvertebrate studies, and clam bioaccumulation studies.

Phase 2. Earthworm Bioaccumulation Studies. Earthworm bioaccumulation studies will be conducted on soils collected from RASS 1. For estimation purposes, it is assumed that bioaccumulation studies will be conducted at 25 percent of the soil sampling locations.

Phase 2. Small Mammal Bioaccumulation. Small mammals will be collected and analyzed to evaluate trends of heavy metal uptake. For planning purposes, it is assumed that twenty animals will be collected for analysis during each sampling episode.

Phase 2. Macroinvertebrate Studies. Macroinvertebrate studies will be conducted in selected areas of RASS 1. For planning purposes, forty plots will be evaluated during each sampling episode.

Phase 2. Clam Bioaccumulation. Clam bioaccumulation studies will be conducted at the seven locations selected for surface water monitoring.

A report would be prepared describing the results of sampling and making recommendations for additional monitoring or remedial actions. The report would also contain an assessment of physical changes in the contaminated areas, such as natural improvement or degradation in habitats or man-made alterations to the sites. Quantities associated with implementation of Alternative 1-2 are presented in Table A.2.

6.1.2.2 Implementation. The major steps required for implementing this alternative are:

a. Design of a detailed sampling and analysis program;
b. Development of action levels and associated responses;
c. Conduct of a systematic sampling and analysis program; and
d. Implementation of active remedial actions, if required.

Detailed Sampling and Analysis Plan. A detailed sampling and analysis plan will be developed for the RASS. At a minimum, this plan will include a

detailed schedule of sampling times, locations, procedures, and analyses. The plan would be prepared to meet the current requirements of regulatory agencies for the preparation of such plans. The plan would also include a detailed Quality Assurance Project Plan (QAPP) and Site Safety Plan (SSP). The sampling and analysis program to be developed by this plan is generally described below.

Development of Action Levels. One of the purposes of environmental monitoring is to identify the need for additional positive actions for site remediation. A precursor to this activity is the development of action levels and associated responses. A detailed plan would be developed to identify action levels and remedial actions that will be triggered if the action levels are exceeded.

Systematic Sampling and Analysis. The requirements of the detailed sampling and analysis plan would be implemented.

Implementation of Active Remedial Actions. If triggered by the results of environmental monitoring, active remedial action measures would be executed.

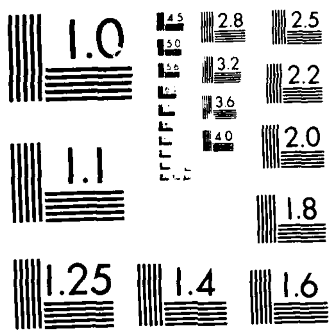
6.1.3 Alternative 1-3A. Excavation/Disposal at Existing Landfills/ Restoration

6.1.3.1 Description. The objective of the Alternative 1-3A is to remove the soils and sediments containing high levels of arsenic and heavy metals from active migration pathways and to dispose of them in an acceptable manner. Application of this alternative is complicated at NWS Concord because the contamination on RASS 1 is located in wetlands, and because Federally and State protected wildlife species are known to inhabit RASS 1. Because of these concerns, habitat restoration is included as a key element of Alternative 1-3A.

Alternative 1-3A includes active remediation on 9.03 acres, passive remediation (continued monitoring) on 23.01 acres, and monitoring on the remainder of the RASS. Quantities associated with implementation of Alternative 1-3A are presented in Table A.3.

AD-A199 116 FEASIBILITY STUDY OF CONTAMINATION REMEDIATION AT NAVAL 5/10
WEAPONS STATION C..(U) ARMY ENGINEER WATERWAYS
EXPERIMENT STATION VICKSBURG MS ENVIR..

UNCLASSIFIED M J CULLINANE ET AL. SEP 88 F/G 24/3 NL


1.0
4.5
5.0
5.6
2.8
3.2
3.6
4.0
2.5
2.2
2.0
1.1
1.8
1.25
1.4
1.6

The excavation and disposal in existing landfills option consists of excavating contaminated materials followed by disposal at an existing permitted facility. Appropriate facilities willing to take each class of contaminated materials have been located and are listed in Table 5.1. The initial concept was to classify materials into the three classes of waste (Class I, Class II, and Class III) with disposal in an appropriate class landfill. Discussion with the California Regional Water Quality Board and Department of Health Services, indicated that the selected clean up criteria (Section 3.4.3.1) will require disposal of all materials in a Class I facility.

The primary means of transportation would be by truck or rail. The excavation would be backfilled to surrounding natural marsh elevations, regraded to existing elevations, and restored. The major components of this alternative consist of the excavation of contaminated material, transport of contaminated materials to an existing land disposal facility, disposal of contaminated materials, restoration of wetlands, and an environmental monitoring program for the restored area as well as those areas in RASS 1 where active remediation is not implemented.

6.1.3.2 Implementation. The major steps in implementing the excavation and off site disposal alternative are:

a. Site preparation and support facilities;
b. Excavation of contaminated materials;
c. Classification of contaminated materials;
d. Transport of contaminated materials to a licensed disposal area;
e. Disposal of the contaminated materials;
g. Grading, revegetation, and restoration of wetlands; and
h. Operation and maintenance, including an environmental monitoring program.

Site Preparation and Support Facilities. RASS 1 would be prepared for remedial construction activities by performing a detailed ground survey of RASS 1 and constructing access roads, haul roads, and parking areas. An equipment/personnel decontamination area would be constructed near the entrance to the active remediation area. This facility would be equipped with a high-pressure spray washer. Cleaning water would be collected and either

treated or shipped off site if required. Trailers would be brought to the site to provide space for offices, locker rooms, laboratories, and storage. Portable chemical toilets would be used to satisfy sanitary requirements.

Excavation. Approximately 9.03 acres would be excavated to a depth of 1 ft. Excavated materials will include the surface vegetation. Excavation of the contaminated materials presents a number of potential problems with respect to implementation in the wetland environment of RASS 1. The primary concerns include the health and safety aspects of excavating materials containing high levels of arsenic and heavy metals, the load bearing capacity of the materials being excavated, and the moisture content of the excavated soils. In addition, care must be taken to ensure that those areas not subject to active remediation are not disturbed unnecessarily.

The primary hazard to workers performing the excavation of contaminated materials will be through skin contact and inhalation of dusts containing arsenic and heavy metals. Workers will require respiratory protection from fugitive dust if remediation activities are conducted during the dry season; however, the possibility of major problems associated with fugitive dust are reduced by the naturally high moisture content of the wetland environment.

In wetland areas, an added concern is the load bearing capacity of the underlying materials. This characteristic of the site and construction scheduling will dictate the type of excavation equipment that will be required. For example, poor load bearing capacity would require the use of complex excavation schemes or site dewatering. At a minimum, low bearing capacity will decrease productivity and increase the cost of excavation. Since the remedial action requires the removal of only the top 12 in. of material in RASS 1, it is anticipated that excavation can be accomplished with either a small bulldozer and front end loader, a dragline, or a clamshell. Proper project scheduling to take advantage of dry season conditions will minimize any problem caused by the high moisture content of the underlying soils.

Materials Classification. Although current data indicates that all excavated soils will be California Class I materials, discussions with State agencies indicate that materials classification may be economical. If studies during

concept design indicate, materials classification will be conducted. A facility will be constructed for classification of the excavated materials to ensure that they are routed to the most economical disposal facility, while ensuring that the the disposal facility selected provides for adequate environmental protection. Materials would be classified as Class I, Class II, or Class III. Classification will be in accordance with the standards of the California Department of Health Services and Regional Water Quality Control Board. The exact basis of classification has not been determined. Materials would be excavated and stockpiled at the classification facility pending the results of testing. After testing and classification, materials would be transported to an existing disposal facility. In addition, soil left in place would be tested to ensure removal in accordance with the remediation decision rules.

Transport of Contaminated Materials. Excavated materials would be transported to the appropriate disposal site in lined and covered trucks or rail cars. Trucks are assumed to have an 18 cubic yard capacity. Rail cars are assumed to have a 64 cubic yard capacity. Liners and covers are required to prevent loss of contaminated materials during transport. State and Federal transportation requirements would dictate the manner in which the soils containing high levels of arsenic and heavy metals are shipped, including the size of trucks or rail cars and the loads that can be carried. Trucks or rail cars would be decontaminated after loading and prior to leaving the contaminated areas.

An additional requirement is the no free liquids regulation implemented under RCRA. Excavation in wetlands may require stockpiling and air drying or treatment of some of the excavated materials.

Contaminated Material Disposal. Class I, Class II, and Class III landfills (Table 5.1) that can accept the contaminated materials have been identified. Materials will be handled in accordance with the requirements of the landfill selected for final disposal.

Backfilling Excavated Areas. Backfilling will be required to return the excavated areas to the required contours for restoration. It is assumed that

an acceptable source of clean backfill material of the proper type can be found within a reasonable distance from RASS 1. For example, several dredged material disposal areas are located in the general vicinity of RASS 1. Soil amendments may be necessary to ensure that the material is suitable for wetland restoration activities. Fill material will have to be tested to obtain specifications for compaction and required amendments. Specifications for compaction would have to address potential difficulties of operating compaction equipment within the excavated areas. Operation of backfilling equipment within the wetland area will be difficult and care must be taken to ensure minimum disturbance of areas adjacent to the excavation area. Seasonal scheduling to avoid high tides and rainy periods will be required during backfilling operations. Because some contamination is being left in place adjacent to the backfilling operation, the health and safety concerns identified for the excavation phase also apply to the backfilling phase.

Grading, Revegetation, and Restoration. Although wetland restoration will be preceded by development of a detailed wetland restoration plan during the design phase, basic considerations are provided in this FS. The feasibility of restoring wetlands on the site to meet basic habitat requirements for both plants and animals is high. Josselyn and Buchholz (1982) tabulated and summarized several successful marsh restoration projects within the San Francisco Bay area. Certain requirements must be met if native wetland plants and animals are to be restored. Assuming the plants are restored to resemble predisturbance conditions, animals formerly occupying the sites should return naturally. A site where natural succession is occurring from a bare dredged material disposal site is a salt pond called Salt Pond #3 near Alameda Creek in south San Francisco Bay. Newling and Landin (1985) described eight years of monitoring this site and conclude that the site was adequately vegetated with native, wetland plants and is being used regularly by indigenous wildlife.

The goal of wetland restoration in RASS 1 is to provide a functioning habitat for the salt marsh harvest mouse, California black rail, and other species that use tidal marshes. Requirements for restoration will be based on two objectives. The first is re-establishment of elevations to create a hydrologic regime suitable for selected wetland plants over the majority of the

excavated area. Therefore, backfilling and grading will be designed to achieve the correct tidal elevation and placement of channels. The second objective is to provide elevation for high marsh and transition zone vegetation that provides escape cover for mice and rails during periods of high tides. This area must be a continuous link between the marsh and the upland.

Plant species and the form of propagule to be used will be selected when the restoration plan is designed. Probable species for the wetland include common pickleweed (*Salicornia virginica*), fat hen (*Atriplex patula*), and alkali heath (*Frankenia grandifolia*). In the high marsh and transition zone, species that tolerate brackish conditions and provide dense cover will be chosen. Revegetation will be mechanized to the greatest extent possible, however, considerable hand work may be required. Fill material, provided it is dredged material or topsoil, should have adequate organic matter and other nutrients essential for plant growth. However, soil amendments such as natural fertilizers (e.g. cow manure) or commercial fertilizers and mulch may have to be added and mixed with the fill material.

Operation and Maintenance. An operation and maintenance program will be conducted for a minimum of 30 years. Maintenance will be necessary for at least five years to ensure that marsh restoration is successful. Semiannual inspections will be conducted, with particular attention given to erosion control and vegetation colonization. Corrective actions of regrading, replanting, etc., will be taken as required.

Operational aspects include a monitoring program for surface water, ground water, soils and sediments, vegetation, and wildlife (described in alternative 1-2). Monitoring will be scheduled for 30 years, but if results show a reduction in contaminant levels and migration, the frequency and extent of monitoring will be reduced after five years.

In areas selected for passive remediation, alternative 1-2 will be implemented. Monitoring will be conducted for 30 years with a review every 5 years to evaluate the need for continued monitoring activities.

6.1.4 Alternative 1-3C. Excavation/Immobilization/Disposal at Existing Landfills/Restoration.

6.1.4.1 Description. An alternative to disposal in a licensed Class I facility is excavation, stabilization, and disposal in a Class III facility. This process effectively changes the hazardous nature of the contaminated material, permitting it to be handled as a non-hazardous material. The major components of this alternative include the development of an effective chemical stabilization process, classification of contaminated material, excavation and stabilization of the contaminated materials, transportation of the excavated soils to an existing Class III disposal facility, disposal of stabilized soils, restoration of wetlands, and an environmental monitoring program for RASS 1. Quantities associated with implementation of Alternative 1-3C are presented in Table A.4.

6.1.4.2 Implementation. The major steps in implementing Alternative 1-3C are:

a. Development of a stabilization process;
b. Site preparation and support facilities;
c. Excavation of contaminated materials;
d. Classification of contaminated materials;
e. Stabilization of contaminants;
f. Transport of contaminated materials to a licensed disposal area;
g. Disposal of the contaminated materials;
h. Backfilling excavated areas with clean material;
i. Grading, revegetation, and restoration of wetlands; and
j. Operation and maintenance, including an environmental monitoring program.

Development of a Stabilization Process. The primary contaminants found in the materials are heavy metals and arsenic. Chemical solidification/stabilization has been proposed as a treatment method for immobilization of heavy metals. Arsenic, however, has proven to be difficult to immobilize. Typical solidification/stabilization methods include cement, pozzolanic, and/or proprietary processes. Typical solidification/stabilization processes require the addition of 25 to 100 percent by weight of binder chemicals (EPA

1986a). For planning purposes, volume increase of 30 percent has been used. In the case of contaminated soils, it may be necessary to add water to ensure that the hydration reactions on which most processes depend actually occur. Wetland soil material will have extremely high concentrations of organic matter that may be difficult to stabilize. A variety of processes may be appropriate for the immobilization of metals in the excavated soils (USEPA 1986a). Processes based on either cement or pozzolon addition have been shown to immobilize heavy metals in a variety of matrices.

Appropriate regulatory agencies will be contacted to determine disposal requirements for the stabilized materials. The California waste classification system uses both a total and a soluble test. This complicates waste reclassification since it is doubtful that chemical stabilization/ solidification processes can meet the total concentration limits. Discussions with State agencies reveal that it is possible to obtain variances (Tornatore 1988). Although formal delisting may not be required, it is believed that regulatory agencies will require some special handling of materials. For cost estimating purposes, it is assumed that Class III disposal will be acceptable. Concerns may be raised over codisposal of the solidified/stabilized materials in a Class III environment.

Site Preparation and Support Facilities. See Alternative 1-3A. In addition, facilities will be provided for adding the stabilization/solidification reagents to the excavated soils. A conceptual plan for such facilities is shown on Plate 6.2.

Excavation. See Alternative 1-3A.

Stabilization of Excavated Soils. The contaminated soils will be stabilized by mixing with dry and possibly liquid reagents in a high powered pug mill or similar device. The proportions of reagents required to ensure stabilization will be determined in the previously described study to develop the stabilization process. After blending, the mixture is allowed to cure for at least 24 hrs before transport to the disposal facility.

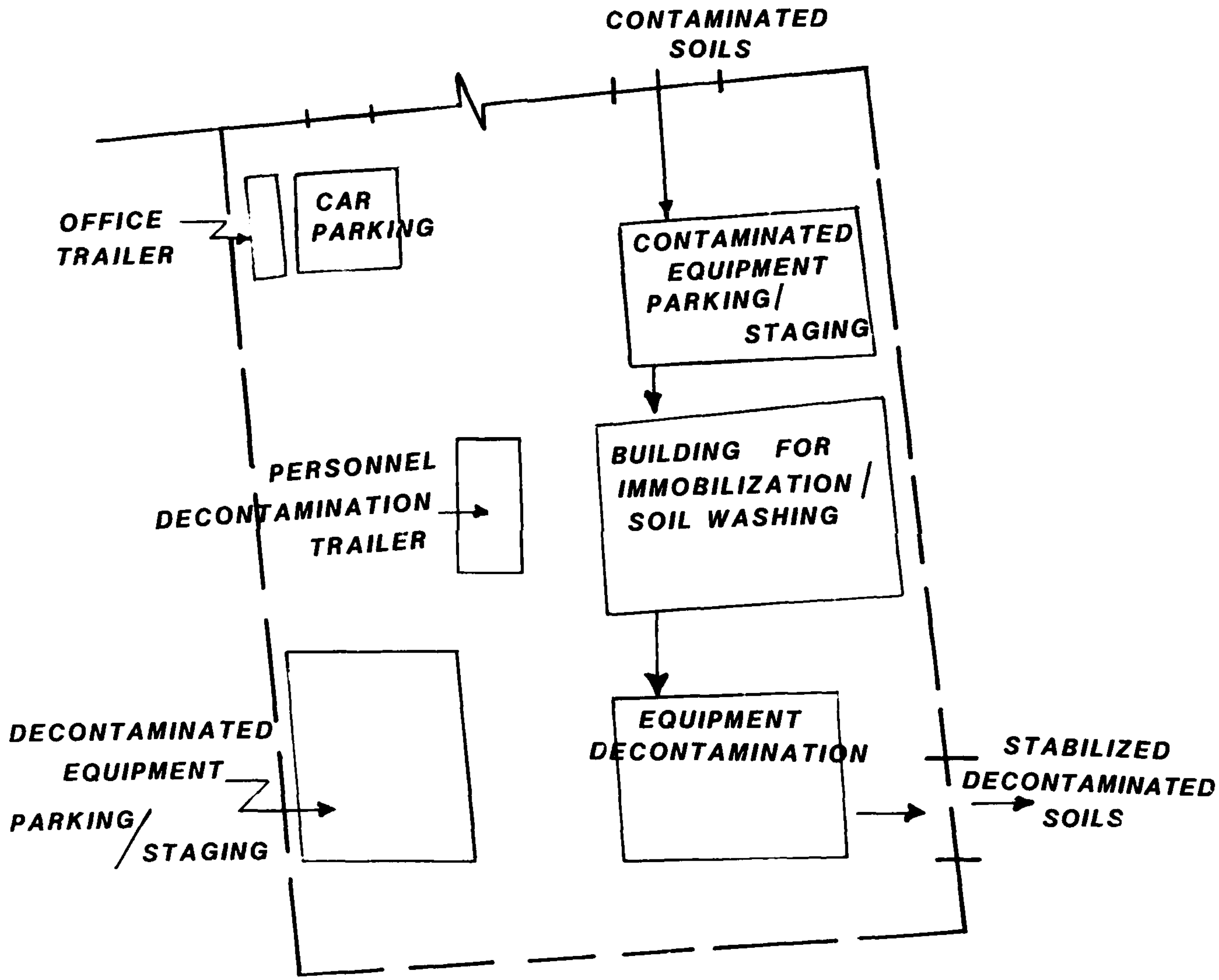


Plate 6.2. Conceptual plan for soil treating facilities.

Transport of Stabilized Soils. See Alternative 1-3A, Transportation of Contaminated Materials. The mode of transportation will be limited to trucks.

Disposal. Stabilized materials will be transported to an existing Class III landfill for final disposal.

Backfilling of Excavated Areas. See Alternative 1-3A.

Grading, Revegetation, and Restoration. See Alternative 1-3A.

Operation and Maintenance of Active Remediation Area. See Alternative 1-3A.

6.1.5 Alternative 1-3D. Excavation/Immobilization/Disposal at Monofill on NWS Concord/Restoration.

6.1.5.1 Description. An alternative to disposal in a licensed off-site facility is excavation, stabilization, and disposal in a monofill located on NWS Concord. The stabilization process effectively changes the hazardous nature of the contaminated material, permitting it to be handled as a non-hazardous material. The major components of this alternative include the development of an effective chemical stabilization process, classification of the contaminated materials, excavation and stabilization of the excavated materials, transportation of the excavated materials to a monofill constructed on NWS Concord, restoration of wetlands, construction of a monofill, an environmental monitoring program for RASS 1, and monitoring of the monofill. Quantities associated with implementation of Alternative 1-3D are presented in Table A.5.

6.1.5.2 Implementation. The major steps in implementing Alternative 1-3D are:

a. Development of a stabilization process;
b. Site preparation and support facilities;
c. Excavation of contaminated materials;
d. Stabilization of excavated soils;
e. Construction of monofill;
f. Transport of solidified/stabilized materials to the disposal area;

g. Disposal of the solidified/stabilized materials;
h. Backfilling excavated areas with clean material;
i. Grading, revegetation, and restoration of wetlands;
j. Operation and maintenance, including an environmental monitoring program, for RASS 1; and
k. Operation and maintenance of the monofill.

Development of a Stabilization Process. See Alternative 1-3C.

Site Preparation and Support Facilities. See Alternative 1-3A.

Excavation. See Alternative 1-3A.

Stabilization of Excavated Soils. See Alternative 1-3C.

Construction of a Monofill. A monofill would be constructed on NWS Concord. The facility would be constructed in accordance with State and Federal requirements. The site has not been selected; however, several candidate sites were investigated by WES (Lutton et al 1987). Because of concerns over the long term durability of the solidified/stabilized soils, the monofill would be constructed to meet Class I engineering standards. Note that Lutton et al (1987) found that none of the available monofill sites on NWS Concord meet the State of California siting requirements for a Class I landfill. The solidification/stabilization process, combined with an engineered monofill constructed to Class I engineering requirements should provide a long term secure environment for the treated soils.

The rational for applying Class I or RCRA requirements to a non-hazardous material include extra protection of ground water, long term stability of the treated soils, and generation of a conservative cost estimate for alternative comparison. It is anticipated that the monofill will include a double liner, leachate collection and treatment system, leak detection system, and a RCRA type cap; however, final design features would be coordinated with the appropriate State and Federal agencies. Anticipated design features are illustrated on Plate 6.2. The monofill would require approximately 13 acres for active disposal operations and a 250 ft. buffer zone.

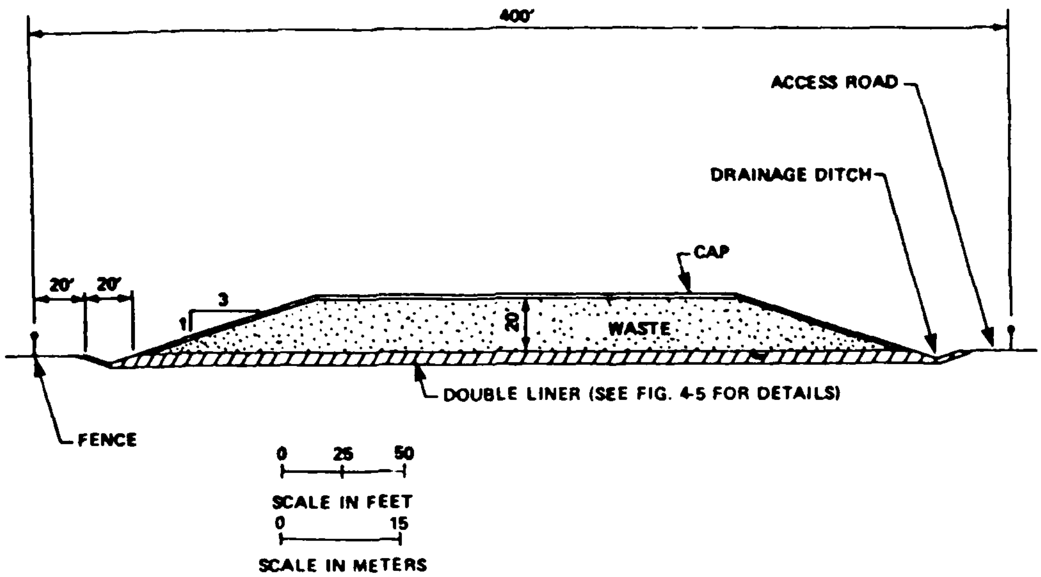


Plate 6.1a. Typical Class I landfill.

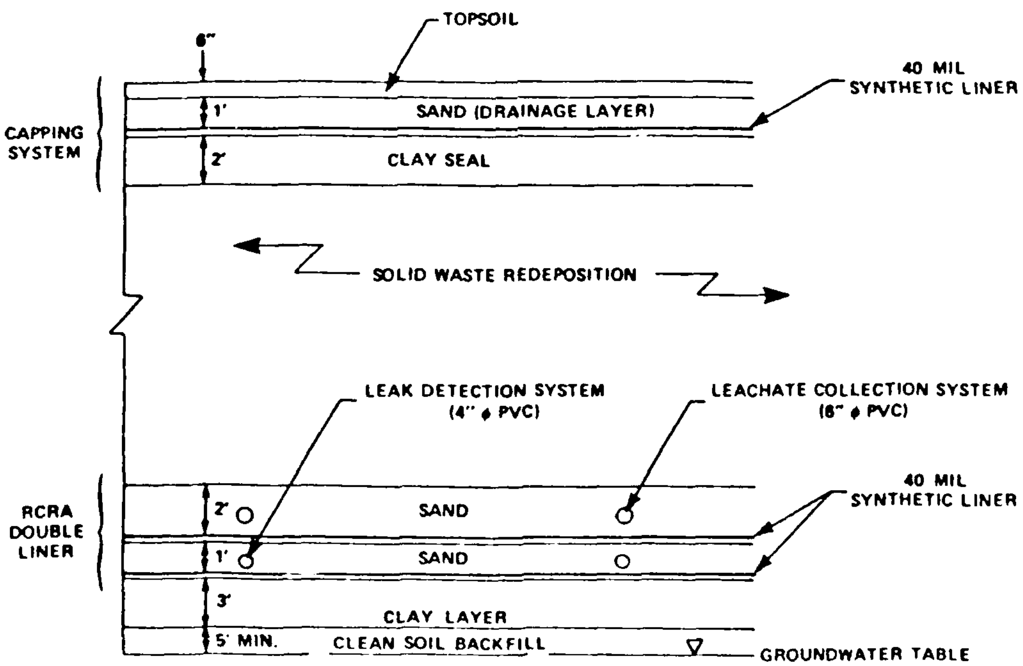


Plate 6.1b. Typical Class I landfill cross section.

Transport of Stabilized Soils. See Alternative 1-3C.

Disposal of Stabilized Soils. Solidified/stabilized soils and Class III materials excavated from the remediation area would be spread in 6-9 in. lifts and compacted. Compaction requirements would be determined by a geotechnical design to ensure that adequate strength is developed to support the cap and overlying materials. Consideration may be given to using the monofill for surface construction; however, close coordination with State and Federal agencies would be required to determine restrictions on joint land use. Following completion of the remediation activities, the solidified/stabilized soils would be covered with a cap meeting Class I or RCRA requirements. Property records would be annotated to clearly delineate the location of the monofill. Deed restrictions would be used to further protect against accidental disturbance of the monofill.

Backfilling of Excavated Areas. See Alternative 1-3A.

Grading, Revegetation, Restoration. See Alternative 1-3A.

Operation and Maintenance of Active Remediation Area. See Alternative 1-3A.

Operation and Maintenance of Monofill. Alternative 1-3D requires long term operation and maintenance of the monofill. Operation and maintenance activities will be conducted in accordance with State and Federal requirements.

6.1.6 Alternative 1-3E. Excavation/Soil Washing/Disposal at Existing Landfills/Restoration.

6.1.6.1 Description. An alternative to disposal in a licensed Class I facility is excavation, soil washing, and disposal in an off-site Class III disposal facility. The excavation followed by soil washing alternative would decontaminate the soils. Rickabaugh, et al. (1986) report that multiple agent treatment may be the most effective means of decontaminating soils. Heavy metal removals of up to 88 percent (Ellis, Fogg and Tafuria 1986) have been achieved using a three agent wash solution technique.

The soil washing process effectively changes the hazardous nature of the contaminated material, permitting it to be handled as a non-hazardous material. The major components of this alternative include the development of an effective soil washing process, excavation and treatment of the excavated soils, transportation of the decontaminated soils to an existing Class III disposal facility, disposal of decontaminated soils, transportation of residual sludges to a Class I disposal facility, disposal of residual sludges, restoration of wetlands, and an environmental monitoring program. Quantities associated with implementation of Alternative 1-3E are presented in Table A.6.

6.1.6.2 Implementation. The major steps in implementing Alternative 1-3E are:

a. Development of a soil washing process;
b. Site preparation and support facilities;
c. Excavation of contaminated materials;
d. Classification of contaminated materials;
e. Treatment of contaminated materials;
f. Transport of decontaminated materials to a licensed disposal area;
g. Transport of residual sludges and spent liquors;
h. Disposal of the decontaminated materials;
i. Disposal of residual sludges and spent liquors;
j. Backfilling excavated areas with clean material;
k. Grading, revegetation, and restoration of wetlands; and
l. Operation and maintenance, including an environmental monitoring program.

Development of a Soil Washing Process. The primary contaminants found in the materials are heavy metals and arsenic. Laboratory and pilot scale tests will be required to determine the appropriate chemicals for washing of the contaminated soil materials. Such a study would be used to define the unit processes required and their operational parameters, including the required reagents and concentrations, temperatures, flows, volumes, etc. Actual materials from RASS 1 would be collected for these studies. Appropriate regulatory agencies will be contacted to determine disposal requirements for the decontaminated materials. Although formal delisting may not be required, it is believed that regulatory agencies will require some special handling of

materials. For cost estimating purposes, it is assumed that Class III disposal will be acceptable for the decontaminated soils. Soil washing technology is somewhat conceptual and presents a high risk of failure. It should be noted that soil washing does not destroy the heavy metals, but simply removes them from the soil and concentrates them into a reduced volume sludge. It is estimated that the volume of sludge will be twenty percent of the volume of treated soil.

Site Preparation and Support Facilities. See Alternative 1-3A. In addition, a soil treatment system would be constructed. The soil treatment system would be designed on the basis of the pilot treatment study discussed above, but for this feasibility analysis, it is assumed that the system will consist of three series upflow column reactors capable of washing 300 cubic yards of contaminated soil per day. The first column would wash the soil with an aqueous surfactant, the next column in the series would apply an acid solution, and the final column in the series would apply a caustic solution to neutralize the materials leaving the second column. The system would include the necessary chemical mix tanks, pipes, valves, pumps, solids conveyors, and instrumentation and control systems. Most if not all of the systems components should be skid mounted to ease installation and increase the possible salvage value. The entire facility could be installed in a tension-fabric structure erected over an asphalt concrete pad underlain by a synthetic membrane with low permeability. Pilot studies may indicate that a simpler system would be sufficient for adequate treatment.

Excavation. See Alternative 1-3A.

Classification of Materials. See Alternative 1-3A.

Treatment of Contaminated Soils. The contaminated soils will be treated in the soil washing system. This work includes conveyance of the excavated materials from the storage structure to the treatment plant, treatment of the contaminated soils, and treatment /recycle/disposal of the spent washing reagents. The contaminated washing reagents will be shipped off-site for disposal in a Class I disposal facility. The possibility of recycling reagents to the greatest extent possible will be investigated during the pilot study.

Since the spent reagents will be liquids, they will be chemically solidified/ stabilized prior to disposal.

Transportation of Treated Soil. Assuming that the soil washing process works, the treated soils could be handled as a "clean soil material" without special restrictions. However, for planning purposes, it is assumed that the treated soils can be handled as a Class III material. Decontaminated soils would be transported to an existing Class III landfill in lined and covered trucks.

Transport of Residual Sludges. Residual sludges and spent liquors from the soil washing process will be transported to an existing Class I disposal facility using either truck or rail transportation. Trucks or rail cars would be lined and covered.

Disposal of Decontaminated Soils. Decontaminated materials will be transported to a Class III landfill for final disposal.

Disposal of Residual Sludges. Residual sludges and spent soil washing liquors will be disposed of in existing Class I disposal facilities.

Backfilling of Excavated Areas. See Alternative 1-3A.

Grading, Revegetation, Restoration. See Alternative 1-3A.

Operation and Maintenance of Active Remediation Area. See Alternative 1-3A.

6.1.7 Alternative 1-3F. Excavation/Soil Washing/Disposal at Monofill on NWS Concord/Restoration.

6.1.7.1 Description. An alternative to disposal in an existing licensed disposal facility is excavation, soil washing, and disposal in a Class III disposal facility located on NWS Concord. The soil washing process effectively changes the hazardous nature of the contaminated material, permitting it to be handled as a non-hazardous material. The major components of this alternative include the development of an effective soil washing process, classification of the contaminated materials, excavation and treatment of the

excavated materials, transportation of the contaminated materials to an appropriate disposal area, backfilling of excavated areas, site grading, site revegetation and restoration, construction of a monofill, and an environmental monitoring program. Quantities associated with implementation of Alternative 1-3F are presented in Table A.7.

6.1.7.2 Implementation. The major steps in implementing Alternative 1-3F are:

a. Development of a soil washing process;
b. Site preparation and support facilities;
c. Excavation of contaminated materials;
d. Classification of contaminated materials;
e. Treatment of contaminated materials;
f. Construction of a monofill on NWS Concord;
g. Transport of decontaminated materials to the disposal area;
h. Transport of residual sludges and spent liquors;
i. Disposal of the decontaminated materials;
j. Disposal of residual sludges and spent liquors;
k. Backfilling excavated areas with clean material;
l. Grading, revegetation, and restoration of wetlands;
m. Operation and maintenance, including an environmental monitoring program of the remediation area; and
n. Operation and maintenance of the monofill.

Development of a Soil Washing Process. See Alternative 1-3E.

Site Preparation and Support Facilities. See Alternative 1-3E.

Construction of a Monofill. A monofill would be constructed on NWS Concord. The facility would be constructed in accordance with State and Federal requirements. The site has not been selected; however, several candidate sites were investigated by WES (Lutton et al 1987). If successful, the soil washing process would remove the contaminants from the soils and concentrate them in residual sludges. Although it is conceivable that the soil washing process could produce a "clean" soil suitable for unrestricted use, for purposes of this FS it is assumed that a monofill for disposal of the treated

soils would be constructed to meet Class III engineering standards. The monofill would require approximately 12 acres for active disposal operations and a 250 ft. buffer zone.

Excavation of Contaminated Soils. See Alternative 1-3A.

Classification of Contaminated Soils. See Alternative 1-3E.

Treatment of Contaminated Soils. See Alternative 1-3E.

Transport of Treated Soils. See Alternative 1-3E.

Transport of Residual Sludges. See Alternative 1-3E.

Disposal of Treated Soils. The soils would be transported to the monofill and placed in 6-9 in. lifts and compacted. Compaction requirements would be based on the characteristics of the treated soil and would be sufficient to provide support for overlying materials and a Class III cover.

Disposal of Residual Sludges. See Alternative 1-3E.

Backfilling of Excavated Areas. See Alternative 1-3A.

Grading, Revegetation, Restoration. See Alternative 1-3A.

Operation and Maintenance of Remediation Area. See Alternative 1-3A.

Operation and Maintenance of Monofill. Alternative 1-3F requires long term operation and maintenance of the monofill. Operation and maintenance activities will be conducted in accordance with State and Federal requirements.

6.2 Remedial Action Subsite 2

6.2.1 Alternative 2-1. No Action

6.2.1.1 Description. The no action alternative involves no active remediation activities. Soils containing high levels of heavy metals (exceeding the TTLC/STLC criterion) would be left in the "as is" condition. No environmental monitoring, other than the proposed surface water and ground water investigation (US Navy 1987) would be implemented. However, some miscellaneous activities should be implemented to provide minimum protection to the public health. Contaminated areas would be posted and property records would be appropriately annotated. Actual on site work would be limited to posting contaminated areas with appropriate warning signs. Quantities associated with implementation of Alternative 2-1 are presented in Table A.8.

6.2.1.2 Implementation. The major steps in implementing the no action alternative are:

a. Development of a contaminated area notification plan,
b. Posting the contaminated area with appropriate signs,
c. Annotation of property records, as appropriate, and
d. Annual inspection and maintenance of posted areas.

Development of Notification Plan. A detailed plan would be developed to ensure that adequate notification is provided to persons on NWS Concord and the general public concerning the presence of contamination on RASS 2.

Posting of Contaminated Areas. Contaminated areas would be posted with appropriate signs to warn both authorized personnel and potential trespassers of the presence of contamination.

Annotation of Property Records. Property records would be annotated to identify the location of the contaminated areas in RASS 2.

Annual Inspection and Maintenance. An annual inspection of RASS 2 would be conducted. Maintenance of warning signs would be conducted during this annual inspection.

6.2.2 Alternative 2-2. Environmental Monitoring

6.2.2.1 Description. The monitoring alternative features the no action alternative, i.e., no remedial action measures (except posting of contaminated areas) combined with periodic environmental monitoring. Materials containing high levels of heavy metals would be left in place. An environmental monitoring program would be implemented to periodically evaluate the environmental status of RASS 2 and adjacent areas. This monitoring program would be oriented to the analysis of environmental changes caused by the migration of contaminants from the areas of high heavy metal concentrations. The environmental monitoring alternative would implement a program of surveillance and monitoring of soil and sediments, surface water, ground water, and biota on RASS 2. The environmental monitoring program is designed to emphasize either 1) those areas of environmental concern identified during the RI or 2) concerns raised by State regulatory agencies. Monitoring would be conducted in two phases.

Phase 1 sampling emphasizes the collection of data on the characteristics of the soil and sediments, surface water, and ground water located on RASS 2 and also implements a program of animal and vegetation observation. The Phase 1 sampling program would be conducted annually during the first five years following implementation of this alternative. Assuming no adverse impacts are identified that would necessitate implementation of an active remedy, Phase 1 sampling would be conducted every five years thereafter. This five year increment is consistent with the five year review required by SARA.

Phase 1. Soil and Sediment Sampling. Surface soil samples from the 0 to 12 in. depth would be collected and analyzed for arsenic, cadmium, copper, lead, selenium, and zinc. Sampling locations would correspond as closely as possible to those locations sampled by Lee et al. (1986). Additional samples would be collected over the remainder of the RASS in the most probable direction of contaminant migration. Soil metal concentrations would be compared to that of previous samples, allowing an evaluation of actual and potential contaminant migration and adverse impacts on the public health and the environment. For planning purposes, 4 soil samples will be collected on RASS 2 during each sampling episode.

Phase 1. Surface Water. Surface water samples would not be collected on RASS 2. However, surface water samples would be collected at seven locations in the creeks and slough located to the west of RASS 1. These locations also include drainage from RASS 2. Water samples would be collected following a period of rainfall. Each sample would be analyzed for total and dissolved arsenic, cadmium, copper, lead, selenium, and zinc to evaluate the mobility of both bound and soluble metals.

Phase 1. Ground Water. Ground water samples would be collected from five monitoring wells. Samples will be analyzed for both total and dissolved arsenic, cadmium, copper, lead, selenium, and zinc.

Phase 1. Wildlife Observation. Observation of wildlife would be conducted once annually. Permanent transects would be established.

Phase 1. Vegetation Observation. Observations of vegetation would be conducted twice annually. Permanent transects would be established.

Phase 1. Site Conditions. Observations of general site conditions would be conducted.

Phase 2 sampling is oriented towards the evaluation of animal and plant populations on the RASS. Phase 2 monitoring for RASS 2 includes: earthworm bioaccumulation studies, small mammal bioaccumulation studies, macroinvertebrate studies, and clam bioaccumulation studies.

Phase 2. Earthworm Bioaccumulation Studies. Earthworm bioaccumulation studies would be conducted on soils collected from RASS 2. For planning purposes, it is assumed that earthworm bioaccumulation studies would be conducted at 50 percent of the soil sampling locations.

Phase 2. Small Mammal Bioaccumulation. Small mammals would be collected and analyzed to evaluate trends of heavy metal uptake. For planning purposes, it is assumed that ten animals would be collected for analysis during each sampling episode.

Phase 2. Macroinvertebrate Studies. Macroinvertebrate studies would be conducted in selected areas of RASS 2. For planning purposes, twenty plots would be evaluated during each sampling episode.

Phase 2. Clam Bioaccumulation. Clam bioaccumulation studies would not be conducted on RASS 2. However, clam biomonitoring would be conducted at seven locations on and adjacent to RASS 1. These locations also include drainage from RASS 2.

A report would be prepared describing the results of sampling and making recommendations for additional monitoring or remedial actions. The report would also contain an assessment of physical changes in the contaminated areas, such as natural improvement or degradation in habitats or man-made alterations. Quantities associated with implementation of Alternative 2-2 are presented in Table A.9.

6.2.2.2 Implementation. The major steps required for implementing this alternative are:

a. Design of a detailed sampling and analysis program;
b. Development of action levels and associated responses;
c. Conduct of a systematic sampling and analysis program; and
d. Implementation of active remedial actions, if required.

Detailed Sampling and Analysis Plan. A detailed sampling and analysis plan will be developed for the RASS. At a minimum, this plan will include a detailed schedule of sampling times, locations, procedures, and analyses. The plan would be prepared to meet the current requirements of regulatory agencies for the preparation of such plans. The plan would also include a detailed Quality Assurance Project Plan (QAPP) and Site Safety Plan (SSP). The sampling and analysis program to be developed by this plan is generally described below.

Development of Action Levels. One of the purposes of environmental monitoring is to identify the need for additional positive actions for site remediation. A precursor to this activity is the development of action levels and associated responses. A detailed plan would be developed to identify action

levels and remedial actions that will be triggered if the action levels are exceeded.

Systematic Sampling and Analysis. The requirements of the detailed sampling and analysis plan would be implemented.

Implementation of Active Remedial Actions. If triggered by the results of environmental monitoring, active remedial action measures would be executed.

6.2.3 Alternative 2-3A. Excavation/Disposal at Existing Landfills/ Restoration

6.2.3.1 Description. The objective of Alternative 2-3A is to remove the soils and sediments containing high levels of heavy metals from active migration pathways and to dispose of them in an acceptable manner. Application of this alternative is complicated at NWS Concord because some of the contamination on RASS 2 are located in wetlands, and because Federally and State protected wildlife species are known to inhabit RASS 2. Because of these concerns, habitat restoration is included as a key element of Alternative 2-3A.

Alternative 2-3A includes active remediation on 4.17 acres and passive remediation (continued monitoring) on 0.94 acres. In addition, monitoring would be conducted on the remainder of the RASS. Quantities associated with implementation of Alternative 2-3A are presented in Table A.10.

The excavation and disposal in existing landfills option consists of excavating contaminated materials followed by disposal at an existing licensed disposal facility. Appropriate facilities willing to take each class of contaminated materials have been located and are listed in Table 5.1. The initial concept is to classify materials into the three classes of waste (Class I, Class II, and Class III) with disposal in an appropriate class landfill located off-site. However, discussions with the State of California Regional Water Quality Control Board and Department of Health Services indicate that the selected clean up criteria (Section 3.4.3.2) will probably require disposal of all materials in a Class I facility.

The primary means of transportation would be by truck or rail. The excavation would be backfilled to surrounding natural marsh elevations, regraded to existing elevations, and restored. The major components of this alternative consist of the excavation of contaminated material, transport of contaminated materials to an existing land disposal facility, disposal of contaminated materials, restoration of wetlands, and an environmental monitoring program for those areas in RASS 2 where active remediation is not implemented.

6.2.3.2 Implementation. The major steps in implementing the excavation and off-site disposal alternative are:

a. Site preparation and support facilities;
b. Excavation of contaminated materials;
c. Classification of contaminated materials;
d. Transport of contaminated materials to a licensed disposal area;
e. Disposal of the contaminated materials;
f. Backfilling excavated areas with clean material;
g. Grading, revegetation, and restoration of wetlands; and
h. Operation and maintenance, including an environmental monitoring program.

Site Preparation and Support Facilities. RASS 2 would be prepared for remedial construction activities by performing a detailed ground survey of each site and constructing access roads, haul roads, and parking areas. An equipment/personnel decontamination area would be constructed near the entrance to the active remediation area. This facility would be equipped with a high-pressure spray-washer. Cleaning water would be collected and either treated or shipped off site if required. Trailers would be brought to the site to provide space for offices, locker rooms, laboratories and storage. Portable chemical toilets would be used to satisfy sanitary requirements.

Excavation. Approximately 3.32 acres would be excavated to a depth of 12 in. and approximately 0.85 acres would be excavated to a depth of 36 in. Excavation of the contaminated materials presents a number of potential problems with respect to implementation in the wetland environment of RASS 2. The primary concerns include the health and safety aspects of excavating contaminated materials, the load bearing capacity of the materials being excavated,

and the moisture content of the excavated materials. In addition, care must be taken to ensure that those areas not subject to active remediation are not disturbed unnecessarily.

The primary hazard to workers performing the excavation of contaminated materials will be through skin contact and inhalation of dusts containing heavy metals. Workers will require respiratory protection from fugitive dust, particularly if remediation activities are conducted during the dry season; however, the possibility of major problems associated with fugitive dust is reduced by the naturally high moisture content of the wetland environment.

In wetland areas, an added concern is the load bearing capacity of the underlying materials. This characteristic of the site and construction scheduling will dictate the type of excavation equipment that will be required. For example, poor load bearing capacity would require the use of complex excavation schemes or site dewatering. At a minimum, low bearing capacity will decrease productivity and increase the cost of excavation. Since the remedial action requires the removal of the top 12 in. of material in RASS 2, it is anticipated that excavation can be accomplished with either a small bulldozer and front end loader, a dragline, or clamshell. A backhoe may be used in the area requiring excavation to a depth of 36 in. Proper project scheduling to take advantage of dry season conditions will minimize any problem caused by the high moisture content of the underlying soils. Note that a bulldozer and loading equipment were used during the dismantling of the kilns located in RASS 2 (Anderson Geotechnical Consultants 1984).

Materials Classification. Based on current data, approximately 3.81 acres exceed the TTLC/STLC criterion and will require disposal in a Class I facility. The remaining 0.36 acres are believed to be below the TTLC/STLC criterion and can be disposed of in a Class III facility. Discussions with State agencies indicates that materials classification may be economical. If studies during concept design indicate, materials classification will be conducted as a cost saving measure. A facility will be constructed for classification of the excavated materials to ensure that they are routed to the most economical disposal facility, while ensuring the the disposal facility selected provides for adequate environmental protection. Materials would be

classified as Class I, Class II, or Class III. Classification will be in accordance with the standards of the California Department of Health Services and Regional Water Quality Control Board. The exact basis of classification has not been determined. Materials would be excavated and stockpiled at the classification facility pending the results of testing. After testing and classification, materials would be transported to an appropriate existing disposal facility. In addition, soils left in place would be tested to ensure removal in accordance with the remediation decision rules.

Transport of Contaminated Materials. Excavated materials would be transported to the selected disposal facility in lined and covered trucks or rail cars. Trucks are assumed to have an 18 cubic yard capacity. Rail cars are assumed to have a 64 cubic yard capacity. Liners and covers are required to prevent loss of contaminated materials during transport. State and Federal transportation requirements would dictate the manner in which the soils containing high levels of heavy metals are shipped, including the size of trucks or rail cars and the loads that can be carried. Trucks or rail cars would be decontaminated after loading and prior to leaving the contaminated areas.

An additional requirement is the no free liquids regulation implemented under RCRA. Excavation in wetlands may require stockpiling and air drying or treatment of some of the excavated materials.

Contaminated Material Disposal. Class I, Class II, and Class III landfills (Table 5.1) have been identified that can accept the contaminated materials. Materials will be handled in accordance with the requirements of the landfill selected for final disposal.

Backfilling Excavated Areas. Backfilling will be required to return the excavated areas to the required contours for restoration. It is assumed that an acceptable source of clean backfill material of the proper type can be found within a reasonable distance from RASS 2. For example, several dredged material disposal areas are located in the general vicinity of RASS 2. Soil amendments may be necessary to ensure that the material is suitable for wetland restoration activities. Fill material will have to be tested to obtain specifications for compaction and required amendments. Specifications for

compaction would have to address potential difficulties of operating compaction equipment within the excavated areas. Operation of backfilling equipment within the wetland area will be difficult and care must be taken to ensure minimum disturbance of areas adjacent to the excavation area. Seasonal scheduling will be required during backfill operations. Because some contamination is being left in place adjacent to the backfilling operation, the health and safety concerns identified for the excavation phase also apply to the backfilling phase. Since RASS 2 includes both wetland and upland areas, sequencing of backfilling operations will be important. Wetland areas should be backfilled first.

Grading, Revegetation, Restoration. Although wetland restoration will be preceded by development of a detailed wetland restoration plan during the design phase, basic considerations are provided in this FS. The feasibility of restoring wetlands on the site to meet basic habitat requirements for both plants and animals is high. Josselyn and Buchholz (1982) tabulated and summarized several successful marsh restoration projects within San Francisco Bay. Certain requirements must be met if native wetland plants and animals are to be restored. Assuming the plants are restored or resemble pre-disturbance conditions, animals formerly occupying the sites should return naturally. A site where natural succession is occurring from a bare dredged material disposal site is a salt pond called Salt Pond #3 near Alameda Creek in south San Francisco Bay. Newling and Landin (1985) described eight years of monitoring this site and conclude the site was adequately vegetated with native, wetland plants and is being used regularly by indigenous wildlife.

The goal of wetland restoration in RASS 2 is to provide functioning habitat for the salt marsh harvest mouse, California black rail, and other species that use tidal marshes. Requirements for restoration will be based on two objectives. The first is re-establishment of elevations to create a hydrologic regime suitable for selected wetland plants over the majority of the excavated area. Therefore, backfilling and grading will be designed to achieve the correct tidal elevation and placement of channels. The second objective is to provide elevation for high marsh and transition zone vegetation that provides escape cover for mice and rails during periods of high tides. This area must be a continuous link between the marsh and the upland.

Plant species and the form of propagule to be used will be selected when the restoration plan is designed. Probable species for the wetland include common pickleweed (Salicornia virginica), fat hen (Atriplex patula), and alkali heath (Frankenia grandifolia). In the high marsh and transition zone, species that tolerate brackish conditions and provide dense cover will be chosen. Revegetation will be mechanized to the greatest extent possible, however, considerable hand work may be required. Fill material, provided it is topsoil, should have adequate organic matter and other nutrients essential for plant growth. However, soil amendments such as natural fertilizers (e.g. cow manure) or commercial fertilizers and mulch may have to be added and mixed with the fill material.

Operation and Maintenance. An operations and maintenance program will be conducted for up to 30 years. Maintenance will be necessary for at least five years to ensure that marsh restoration is successful. Semiannual inspections will be conducted, with particular attention given to erosion control and vegetation colonization. Corrective actions of regrading, replanting, etc., will be taken as required.

Operational aspects include a monitoring program for surface water, ground water, soils and sediments, vegetation, and wildlife (described in alternative 2-2). Monitoring will be scheduled for 30 years, but if results show a reduction in contaminant levels and migration, monitoring will be discontinued after five years.

In areas selected for passive remediation, Alternative 2-2 will be implemented. Monitoring will be conducted for 30 years with a review every 5 years to evaluate the need for continued monitoring activities.

6.2.4 Alternative 2-3C. Excavation/Immobilization/Disposal at Existing Landfills/Restoration.

6.2.4.1 Description. An alternative to disposal in a licensed Class I facility is excavation, stabilization, and disposal in a Class III disposal facility. This process effectively changes the hazardous nature of the contaminated material, permitting it to be handled as a non-hazardous material.

The major components of this alternative include the development of an effective chemical stabilization process, excavation of contaminated materials, classification of materials, stabilization of the contaminated materials, transportation of the excavated soils to an existing Class III disposal facility, disposal of stabilized soils, restoration of wetlands, and an environmental monitoring program for RASS 2. Quantities associated with implementation of Alternative 2-3C are presented in Table A.11.

6.2.4.2 Implementation. The major steps in implementing Alternative 2-3C are:

a. Development of a stabilization process;
b. Site preparation and support facilities;
c. Excavation of contaminated materials;
d. Classification of contaminated materials;
e. Stabilization of contaminants;
f. Transport of contaminated materials to a licensed disposal area;
g. Disposal of the contaminated materials;
h. Backfilling excavated areas with clean material;
i. Grading, revegetation, and restoration of wetlands; and
j. Operation and maintenance, including an environmental monitoring program.

Development of a Stabilization Process. The primary contaminants found in the materials are the heavy metals. Chemical solidification/ stabilization has been proposed as a treatment method for immobilization of heavy metals. Typical solidification/stabilization methods include cement, pozzolanic, and/or proprietary processes. Typical solidification/stabilization processes require the addition of 25 to 100 percent by weight of chemicals. In the case of contaminated soils, it may be necessary to add water to assure that the hydration reactions on which most processes depend actually occur. Wetland soil material will have extremely high concentrations of organic matter that may be difficult to stabilize. A variety of processes may be appropriate for the immobilization of metals in the excavated soils (USEPA 1986a). Processes based on either cement or pozzolon addition have been shown to immobilize heavy metals in a variety of matrices.

Appropriate regulatory agencies will be contacted to determine disposal requirements for the stabilized materials. The California waste classification system uses both a total and soluble criterion. This complicates waste reclassification since it is doubtful that chemical stabilization/solidification processes can meet the total concentration limits. Discussions with state agencies reveal that it is possible to obtain variances (Tornatore 1988). Although formal delisting may not be required, it is believed that regulatory agencies will require some special handling of materials. For cost estimating purposes, it is assumed that Class III disposal will be acceptable. Concerns may be raised over the codisposal of the solidified/stabilized materials in a Class III environment.

Site Preparation and Support Facilities. See Alternative 2-3A.

Excavation. See Alternative 2-3A.

Stabilization of Excavated Soils. The contaminated soils will be stabilized by mixing with dry and possibly liquid reagents in a high powered pug mill or similar device. The proportions of reagents required to ensure stabilization will be determined in the previously described study to develop the stabilization process. After blending, the mixture is allowed to cure for at least 24 hrs before transport to the disposal facility.

Transport. See Alternative 2-3A.

Disposal. Stabilized materials will be transported to an existing Class III landfill for final disposal.

Backfilling of Excavated Areas. See Alternative 2-3A.

Grading, Revegetation, Restoration. See Alternative 2-3A.

Operation and Maintenance of Remediation Area. See Alternative 2-3A.

6.2.5 Alternative 2-3D. Excavation/Immobilization/Disposal at Monofill on NWS Concord/Restoration.

6.2.5.1 Description. An alternative to disposal in a licensed off-site facility is excavation, stabilization, and disposal in a monofill located on NWS Concord. The stabilization process effectively changes the hazardous nature of the contaminated material, permitting it to be handled as a non-hazardous material. The major components of this alternative include the development of an effective chemical stabilization process, classification of the contaminated materials, excavation and stabilization of the excavated materials, transportation of the excavated materials to a monofill constructed on NWS Concord, restoration of wetlands, construction of a monofill, an environmental monitoring program for RASS 2, and monitoring of the monofill. Quantities associated with implementation of Alternative 2-3D are presented in Table A.12.

6.2.5.2 Implementation. The major steps in implementing Alternative 2-3D are:

a. Development of a stabilization process;
b. Site preparation and support facilities;
c. Excavation of contaminated materials;
d. Stabilization of excavated soils;
e. Construction of a monofill;
f. Transport of solidified/stabilized materials to the monofill;
g. Disposal of the solidified/stabilized materials;
h. Backfilling excavated areas with clean material;
i. Grading, revegetation, and restoration of wetlands;
j. Operation and maintenance, including an environmental monitoring program for RASS 2; and
k. Operation and maintenance of the monofill.

Development of a Stabilization Process. See Alternative 2-3C.

Site Preparation and Support Facilities. See Alternative 2-3A.

Excavation. See Alternative 2-3A.

Stabilization of Excavated Soil. See Alternative 2-3C.

Construction of a Monofill. A monofill would be constructed on NWS Concord. The facility would be constructed in accordance with State and Federal requirements. The site has not been selected; however, several candidate sites were investigated by WES (Lutton et al 1987). Because of concerns over the long term durability of the solidified/stabilized soils, the monofill would be constructed to meet Class I engineering standards. Note that Lutton et al (1987) found that none of the available monofill sites on NWS Concord meet the State of California siting requirements for a Class I landfill. The solidification/stabilization process, combined with an engineered monofill constructed to Class I engineering requirements will provide a long term secure environment for the treated soils.

The rational for applying Class I or RCRA requirements to a non-hazardous material include extra protection of ground water, long term stability of the treated soils, and generation of a conservative cost estimate for alternative comparison. It is anticipated that the monofill will include a double liner, leachate collection and treatment system, leak detection system, and a RCRA type cap; however, final design features would be coordinated with the appropriate State and Federal agencies. Anticipated design features are illustrated on Plate 6.2. The monofill will require approximately 10 acres for active landfill operations plus a 250 ft. buffer zone.

Transport of Stabilized Soils. See Alternative 2-3A.

Disposal of Stabilized Soils. Solidified/stabilized soils and Class III materials excavated from the remediation area would be spread in 6-9 in. lifts and compacted. Compaction requirements would be determined by a geotechnical design to ensure that adequate strength is developed to support the cap and overlying materials. Consideration may be given to using the monofill for surface construction; however, close coordination with State and Federal agencies would be required to determine restrictions on joint land use. Following completion of the remediation activities, the solidified/stabilized soils would be covered with a cap meeting Class I or RCRA requirements. Property records would be annotated to clearly delineate the location of the

monofill. Deed restrictions would be used to further protect against accidental disturbance of the monofill.

Backfilling of Excavated Areas. See Alternative 2-3A.

Grading, Revegetation, Restoration. See Alternative 2-3A.

Operation and Maintenance of Remediation Area. See Alternative 2-3A.

Operation and Maintenance of Monofill. Alternative 1-3D requires long term operation and maintenance of the monofill. Operation and maintenance activities will be conducted in accordance with State and Federal requirements.

6.2.6 Alternative 2-3E. Excavation/Soil Washing/Disposal at Existing Landfills/Restoration.

6.2.6.1 Description. An alternative to disposal in a licensed Class I facility is excavation, soil washing, and disposal in an off-site Class III disposal area. The soil washing process effectively changes the hazardous nature of the contaminated material, permitting it to be handled as a non-hazardous material. The major components of this alternative include the development of an effective soil washing process, excavation and treatment of the excavated soils, transportation of the decontaminated soils to an existing Class III disposal facility, disposal of decontaminated soils, transportation of residual sludges to a Class I disposal facility, disposal of residual sludges, restoration of wetlands, and an environmental monitoring program for RASS 3. Quantities associated with implementation of Alternative 2-3E are presented in Table A.13.

6.2.6.2 Implementation. The major steps in implementing Alternative 2-3E are:

a. Development of a soil washing process;
b. Site preparation and support facilities;
c. Excavation of contaminated materials;
d. Classification of contaminated materials;
e. Treatment of contaminated materials;

f. Transport of decontaminated materials to a licensed disposal area;
g. Transport of residual sludges and spent liquors;
h. Disposal of the decontaminated materials;
i. Disposal of residual sludges and spent liquors;
j. Backfilling excavated areas with clean material;
k. Grading, revegetation, and restoration of wetlands; and
l. Operation and maintenance, including an environmental monitoring program for RASS 2.

Development of a Soil Washing Process. The primary contaminants found in the materials are the heavy metals. Laboratory and pilot scale tests will be required to determine the appropriate chemicals for washing of the contaminated soil materials. Such a study should be used to define the unit processes required and their operational parameters, including the required reagents and concentrations, temperatures, flows, volumes, etc. Actual materials from RASS 2 should be collected for these studies. Appropriate regulatory agencies will be contacted to determine disposal requirements for the decontaminated materials. Although formal delisting may not be required, it is believed that regulatory agencies will require some special handling of materials. For cost estimating purposes, it is assumed that Class III disposal will be acceptable for the decontaminated soils. Soil washing technology is somewhat conceptual and presents a high risk of failure. It should be noted that the soil washing process does not destroy the heavy metals, but simply removes them from the soil and concentrates them into a reduced volume of sludge. It is estimated that the volume of sludge will be twenty percent of the volume of treated soil.

Site Preparation and Support Facilities. See Alternative 2-3A. In addition, a soil treatment system would be constructed. The soil treatment system would be designed on the basis of the pilot treatment study discussed above, but for this feasibility analysis, it is assumed that the system will consist of three series upflow column reactors capable of washing 300 cubic yards of contaminated soil per day. The first column would wash the soil with an aqueous surfactant, the next column in the series would apply an acid solution, and the final column in the series would apply a caustic solution to neutralize the materials leaving the second column. The system would include the necessary

chemical mix tanks, pipes, valves, pumps, solids conveyors, and instrumentation and control systems. Most if not all of the systems components should be skid mounted to ease installation and increase the possible salvage value. The entire facility could be installed in a tension-fabric structure erected over an asphalt concrete pad underlain by a synthetic membrane with low permeability. Pilot studies may indicate that a simpler system would be sufficient for adequate treatment.

Excavation. See Alternative 2-3A.

Classification of Materials. See Alternative 2-3A.

Treatment of Excavated Soils. The contaminated soils will be treated in the soil washing system. This work includes conveyance of the excavated materials from the storage structure to the treatment plant, treatment of the contaminated soils, and treatment/recycle/disposal of the spent washing reagents. The contaminated washing reagents will be shipped off-site for disposal in a Class I disposal facility. The possibility of recycling reagents to the greatest extent possible will be investigated during the pilot study. Since the spent reagents will be liquids, they will be chemically solidified/stabilized prior to disposal.

Transport of Treated Soils. Assuming that the soil washing process works, the treated soils could be handled as a "clean soil material" without special restrictions. However, for planning purposes, it is assumed that the treated soils can be handled as a Class III material. Decontaminated soils would be transported to the monofill in lined and covered trucks.

Transportation of Residual Sludges. Residual sludges and spent liquors from the soil washing process will be transported to an existing Class I disposal facility using either truck or rail transportation. Trucks or rail cars would be lined and covered.

Disposal of Decontaminated Soils. Decontaminated materials will be transported to an existing Class III landfill for final disposal.

Disposal of Residual Sludges. Residual sludges and spent soil washing liquors will be disposed of in existing Class I disposal facilities.

Backfilling of Excavated Areas. See Alternative 2-3A.

Grading, Revegetation, Restoration. See Alternative 2-3A.

Operation and Maintenance of Remediation Area. See Alternative 2-3A.

6.2.7 Alternative 2-3F. Excavation/Soil Washing/Disposal at Monofill on NWS Concord/Restoration.

6.2.7.1 Description. An alternative to disposal of the decontaminated soils in an existing licensed Class III disposal facility is excavation, soil washing, and disposal in a Class III disposal facility located on NWS Concord. The soil washing process effectively changes the hazardous nature of the contaminated material, permitting it to be handled as a non-hazardous material. The major components of this alternative include the development of an effective soil washing process, classification of the contaminated materials, excavation and treatment of the excavated materials, transportation of the contaminated materials to an appropriate disposal facility, wetland restoration, construction of a monofill, and an environmental monitoring program. Quantities associated with implementation of Alternative 2-3F are presented in Table A.14.

6.2.7.2 Implementation. The major steps in implementing Alternative 2-3F are:

a. Development of a soil washing process;
b. Site preparation and support facilities;
c. Excavation of contaminated materials;
d. Classification of contaminated materials;
e. Treatment of contaminated materials;
f. Construction of a monofill on NWS Concord;
g. Transport of decontaminated materials to the disposal area;
h. Transport of residual sludges and spent liquors;
i. Disposal of the decontaminated materials;

j. Disposal of residual sludges and spent liquors;

k. Backfilling excavated areas with clean material;

l. Grading, revegetation, and restoration of wetlands;

m. Operation and maintenance, including an environmental monitoring program of the remediation area; and

n. Operation and maintenance of the monofill.

Development of a Soil Washing Process. See Alternative 2-3E.

Site Preparation and Support Facilities. See Alternative 2-3E.

Construction of a Monofill. A monofill would be constructed on NWS Concord. The facility would be constructed in accordance with State and Federal requirements. The site has not been selected; however, several candidate sites were investigated by WES (Lutton et al 1987). If successful, the soil washing process would remove the contaminants from the soils and concentrate them in residual sludges. Although it is conceivable that the soil washing process could produce a "clean" soil suitable for unrestricted use, for purposes of this FS it is assumed that a monofill for disposal of the treated soils would be constructed to meet Class III engineering standards. The monofill will require approximately 10 acres for active disposal plus a 250 ft. buffer zone.

Excavation of Contaminated Soils. See Alternative 2-3C.

Classification of Contaminated Soils. See Alternative 2-3A.

Treatment of Contaminated Soils. See Alternative 2-3E.

Transport of Treated Soils. See Alternative 2-3E.

Transport of Residual Sludges. See Alternative 2-3E.

Disposal of Treated Soils. The soils would be transported to the monofill and placed in 6-9 in. lifts and compacted. Compaction requirements would be based

on the characteristics of the treated soil and would be sufficient to provide support for overlying materials and a Class III cover.

Disposal of Residual Sludges. See Alternative 2-3E.

Backfilling of Excavated Areas. See Alternative 2-3A.

Grading, Revegetation, Restoration. See Alternative 2-3A.

Operation and Maintenance of Remediation Area. See Alternative 2-3A.

Operation and Maintenance of Monofill. Alternative 2-3F requires long term operation and maintenance of the monofill. Operation and maintenance activities will be conducted in accordance with State and Federal requirements.

6.3 Remedial Action Subsite 3

6.3.1 Alternative 3-1. No Action

6.3.1.1 Description. The no action alternative involves no active remediation activities. Soils containing high levels of heavy metals (exceeding TTLC/STLC criterion) would be left in the "as is" condition. No environmental monitoring, other than the proposed surface water and ground water investigation (US Navy 1987) would be implemented. However, some miscellaneous activities should be implemented to provide minimum protection of the public health. Contaminated areas would be posted and property records would be appropriately annotated. Actual on site work would be limited to posting contaminated areas with appropriate warning signs. Quantities associated with implementation of Alternative 3-1 are presented in Table A.15.

6.3.1.2 Implementation. The major steps in implementing the no action alternative are:

a. Development of a contaminated area notification plan,
b. Posting the contaminated area with appropriate signs,
c. Annotation of property records, as appropriate, and
d. Annual inspection and maintenance of posted areas.

Development of Notification Plan. A detailed plan would be developed to ensure that adequate notification is provided to persons on NWS Concord and the general public concerning the presence of contamination on RASS 3.

Posting of Contaminated Areas. Contaminated areas would be posted with appropriate signs to warn both authorized personnel and potential trespassers of the presence of contamination.

Annotation of Property Records. Property records would be annotated to identify the location of the contaminated areas in RASS 3.

Annual Inspection and Maintenance. An annual inspection of RASS 3 would be conducted. Maintenance of warning signs would be conducted during this annual inspection.

6.3.2 Alternative 3-2. Environmental Monitoring

6.3.2.1 Description. The environmental monitoring alternative features the no action alternative, i.e., no active remedial action measures (except posting of contaminated areas) combined with extensive and continuing environmental monitoring. Materials containing high levels of heavy metals would be left in place. An environmental monitoring program would be implemented to periodically evaluate the environmental status of RASS 3 and adjacent areas. This monitoring program would be oriented to the analysis of environmental changes caused by the expected continued migration of contaminants from the areas of high heavy metal concentrations.

The environmental monitoring alternative would implement a program of surveillance and monitoring of soil and sediments, surface water, ground water, air, and biota on RASS 3. The environmental monitoring program is designed to emphasize either 1) those areas of environmental concern identified during the RI or 2) concerns raised by State regulatory agencies. Monitoring would be conducted in two phases.

Phase 1 sampling emphasizes the collection of data on the characteristics of the soil and sediments, surface water, and ground water located on RASS 3 and

also implements a program of animal and vegetation observation. The Phase 1 sampling program would be conducted annually during the first five years following implementation of this alternative. Assuming no adverse impacts are identified that would necessitate implementation of an active remedy, Phase 1 sampling would be conducted every five years thereafter. This five year increment is consistent with the five year review by SARA.

Phase 1. Soil and Sediment Sampling. Surface soil samples from the 0 to 12 in. depth would be collected and analyzed for arsenic, cadmium, copper, lead, selenium, and zinc. Sampling locations would correspond as closely as possible to those locations sampled by Lee et al. (1986). Additional samples would be collected over the remainder of the RASS in the most probable direction of contaminant migration. Soil metal concentrations would be compared to that of previous samples, thus allowing an evaluation of the potential for contamination migration and adverse impacts on the public health and the environment. For planning purposes, 4 soil samples will be collected on RASS 3 during each sampling episode.

Phase 1. Surface Water. Surface water samples would be collected at one location on RASS 3, located upstream of the Chemical and Pigment Company plant. Surface water samples would also be collected at seven locations in the creeks and slough located to the west of RASS 1. These locations also include drainage from RASS 3. Water samples would be collected following a period of rainfall. Each sample would be analyzed for total and dissolved arsenic, cadmium, copper, lead, selenium, and zinc to evaluate the mobility of both bound and soluble metals.

Phase 1. Ground Water. Ground water samples would be collected from six monitoring wells. Samples will be analyzed for both total and dissolved arsenic, cadmium, copper, lead, selenium, and zinc.

Phase 1. Wildlife Observation. Observation of wildlife would be conducted once annually. Permanent transects would be established.

Phase 1. Vegetation Observation. Observations of vegetation would be conducted twice annually. Permanent transects would be established.

Phase 1. Site Conditions. Observations of general site conditions would be conducted.

Phase 2 sampling is oriented towards the evaluation of animal and plant populations on the RASS. Phase 2 monitoring for RASS 3 includes: earthworm bioaccumulation studies and clam bioaccumulation studies.

Phase 2. Earthworm Bioaccumulation Studies. Earthworm bioaccumulation studies would be conducted on soils collected from RASS 3. For planning purposes, it is assumed that bioaccumulation studies would be conducted at 50 percent of the soil sampling locations.

Phase 2. Clam Bioaccumulation. Clam bioaccumulation studies would not be conducted on RASS 3. However, clam biomonitoring will be conducted at seven locations on and adjacent to RASS 1. These locations also include drainage from RASS 3.

A report would be prepared describing the results of sampling and making recommendations for additional monitoring or remedial actions. The report will also contain an assessment of physical changes in the contaminated areas, i.e., natural improvement or degradation in habitats, man-made alterations, etc. Quantities associated with implementation of Alternative 3-2 are presented in Table A.16.

6.3.2.2 Implementation. The major steps required for implementing this alternative are:

a. Design of a detailed sampling and analysis program;
b. Development of action levels and associated responses;
c. Conduct of a systematic sampling and analysis program; and
d. Implementation of additional remedial actions as required.

Detailed Sampling and Analysis Plan. A detailed sampling and analysis plan will be developed for the RASS. At a minimum, this plan will include a detailed schedule of sampling times, locations, procedures, and analyses. The plan would be prepared to meet the current requirements of regulatory agencies

for the preparation of such plans. The plan would also include a detailed Quality Assurance Project Plan (QAPP) and Site Safety Plan (SSP).

The sampling and analysis program to be developed by this plan is generally described below.

Development of Action Levels. One of the purposes of environmental monitoring is to identify the need for additional positive actions for site remediation. A precursor to this activity is the development of action levels and associated responses. A detailed plan would be developed to identify action levels and remedial actions that will be triggered if the action levels are exceeded.

Systematic Sampling and Analysis. The requirements of the detailed sampling and analysis plan would be implemented.

Implementation of Active Remedial Actions. If triggered by the results of environmental monitoring, active remedial action measures would be executed.

6.3.3 Alternative 3-3A. Excavation/Disposal at Existing Landfills/ Revegetation

6.3.3.1 Description. The objective of Alternative 3-3A is to remove the soils and sediments containing high levels of heavy metals from active migration pathways and to dispose of them in an acceptable manner. Application of this alternative is complicated at NWS Concord because some of the contamination on RASS 2 is located in wetlands, and because Federally and State protected wildlife species are known to inhabit sites adjacent to RASS 3. Thus any remediation efforts in RASS 3 must consider impacts on adjacent subsites (RASS 1 and RASS 2). Although an active wetland restoration program is not considered necessary for RASS 3, design features would be included to insure the natural return of vegetation to the area. Quantities associated with implementation of Alternative 3-3A are presented in Table A.17.

The excavation and disposal in existing landfills option consists of excavating contaminated materials followed by disposal at an existing licensed

disposal facility. Appropriate facilities willing to take each class of contaminated materials have been located and are listed in Table 5.1. The initial concept is to classify excavated materials into the three waste classes (Class I, Class II, and Class III) with disposal in an appropriate class landfill located off-site. Preliminary discussion with the State of California Regional Water Quality Control Board and Department of Health Services indicate that the selected clean up criteria (Section 3.4.3.3) will produce both Class I and Class III materials. The primary means of transportation will be by truck or rail for Class I materials and truck for Class III materials.

RASS 3 is a riparian drainageway that includes upland and freshwater wetland characterized by Nichols Creek and an unnamed tributary which flow through the area. Rather than backfilling the excavated areas, the final grading plan would include creation of a wide freshwater wetland area on the lower portion of the RASS. The preferred site would be as far downstream, but still south of the Southern Pacific trestle, as possible. The wetland created by excavation would serve as a sedimentation area and would trap any contaminated sediment moving along Nichols Creek. Contaminants would thus be prevented from moving into the more environmentally sensitive wetland area north of the Southern Pacific railroad. Although backfilling to existing contours would not be accomplished, some soil amendments may be necessary to ensure prompt regrowth of vegetation. The major components of this alternative consist of the excavation of contaminated material, transportation of contaminated materials to an existing disposal facility for contaminated materials, grading and revegetation, and an environmental monitoring program.

6.3.3.2 Implementation. The major steps in implementing the excavation and off site disposal alternative are:

a. Site preparation and support facilities;
b. Excavation of contaminated materials;
c. Classification of contaminated materials;
d. Transport of contaminated materials to a licensed disposal area;
e. Disposal of the contaminated materials;
f. Grading, drainage improvements and revegetation; and
g. Operation and maintenance.

Site Preparation and Support Facilities. RASS 3 would be prepared for remedial construction activities by performing a detailed ground survey o each site and constructing access roads, haul roads, and parking areas. An equipment/personnel decontamination area would be constructed near the entrance to the active remediation area. This facility would be equipped with a high-pressure spray washer. Cleaning water would be collected and either treated or shipped off site if required. Trailers would be brought to the site to provide space for offices, locker rooms, laboratories and storage. Portable chemical toilets would be used to satisfy sanitary requirements.

Excavation. Approximately 4.66 acres would be excavated to a depth of 1 ft. Excavation of the contaminated materials presents a number of potential problems with respect to implementation in the wetland environment of RASS 3. The primary concerns include the health and safety aspects of excavating contaminated materials, the load bearing capacity of the materials being excavated, and the moisture content of the excavated materials. In addition, care must be taken to ensure that those areas not subject to active remediation are not disturbed unnecessarily.

The primary hazard to workers performing the excavation of contaminated materials will be through skin contact and inhalation of dusts containing heavy metals. Although most of the excavation consists of cleaning out ditches, some work in upland areas may generate dust problems. Therefore, workers may require respiratory protection from fugitive dust if excavation is conducted during the dry season; however, the possibility of major problems associated with fugitive dust is reduced by the naturally high moisture contents expected in the wetlands and adjacent areas found in RASS 3.

The load bearing capacity of the underlying materials in RASS 3 may be of some concern. This characteristic of the site and construction scheduling will dictate the type of excavation equipment that will be required. For example, poor load bearing capacity or poor scheduling would require the use of complex excavation schemes or site dewatering. At a minimum, low bearing capacity will decrease productivity and increase the cost of excavation. Since the remedial action requires the removal of only the top 12 in. of material in RASS 3, it is anticipated that excavation can be accomplished with either a small

bulldozer and front end loader, backhoe, dragline, or clamshell. Proper project scheduling to take advantage of dry season conditions on RASS 3 will minimize any problem caused by the high moisture content of the underlying soils. It should be noted that normal drainage maintenance has been conducted without difficulty using a backhoe and other similar equipment.

Materials Classification. Based on current data, approximately 1.92 of the 4.66 acres to be excavated exceed the TTLC/STLC criterion and will require Class I disposal. The remaining 2.74 acres are believed to be below the TTLC/STLC criterion and can be disposed of in a Class III facility. Discussions with State agencies indicates that materials classification may be economical. If studies conducted during concept design indicate, materials classification will be implemented as a cost saving measure. A facility will be constructed for classification of the excavated materials to ensure that they are routed to the most economical disposal facility, while ensuring the the disposal facility selected provides for adequate environmental protection. Materials would be classified as Class I, Class II, or Class III. Classification will be in accordance with the standards of the California Department of Health Services and Regional Water Quality Control Board. The exact basis of classification has not been determined. Materials would be excavated and stockpiled at the classification facility pending the results of testing. In addition, soils left in place would be tested to ensure removal in accordance with the remediation decision rules.

Transport of Contaminated Materials. Excavated materials would be transported to the appropriate disposal facility in lined and covered trucks or rail cars. Trucks are assumed to have an 18 cubic yard capacity. Rail cars are assumed to have a 64 cubic yard capacity. Liners and covers are required to prevent loss of contaminated materials during transport. State and Federal transportation requirements would dictate the manner in which the soils containing high levels of heavy metals are shipped, including the size of trucks and the loads that can be carried. An additional requirement is the no free liquids regulation implemented under RCRA. Excavation in wetlands may require stockpiling and air drying of some of the excavated materials. Trucks or rail cars would be decontaminated after loading and prior to leaving the contaminated areas.

Contaminated Material Disposal. Class I, Class II, and Class III landfills (Table 5.1) have been identified that can accept the contaminated materials. Materials will be handled in accordance with the requirements of each landfill.

Grading, Drainage Improvements, and Revegetation. Grading, drainage improvements and revegetation of wetlands in RASS 3 will be accomplished by contouring the excavated area to an elevation that will support freshwater wetland vegetation. Drainage improvements would also be made to ensure protection of upstream and downstream property owners. Revegetation is expected to occur naturally within a few months. The wetland will include a depression at the west end of RASS 3 to trap sediments. Backfilling and/or soil amendments will be applied during the grading process to expedite the revegetation process.

Operation and Maintenance. The operation and maintenance requirements associated with the active remediation implemented under Alternative 3-3A are minimal. The operation and maintenance program will be conducted for 5 years. Maintenance will consist of an annual inspection and implementation of required corrective actions to ensure that the grading and revegetation are successful. Particular attention will be given to erosion control and vegetation colonization. A 30 year program of environmental monitoring including surface water, soil and sediment, ground water, and wildlife studies (described in Alternative 3-2) would be implemented.

6.3.4 Alternative 3-3C. Excavation/Immobilization/Disposal at Existing Landfills/Revegetation.

6.3.4.1 Description. An alternative to disposal in an existing licensed Class I disposal facility is excavation, stabilization, and disposal in an existing Class III disposal facility. This process effectively changes the hazardous nature of the contaminated material, permitting it to be handled as a non-hazardous material. The major components of this alternative include the development of an effective chemical stabilization process, excavation of contaminated materials, classification of materials, stabilization of the excavated materials, transportation of the excavated materials to an existing

Class III disposal facility, site grading and revegetation, and an environmental monitoring program for RASS 3. Quantities associated with implementation of Alternative 3-3C are presented in Table A.18.

6.3.4.2 Implementation. The major steps in implementing Alternative 3-3C are:

a. Development of a stabilization process;
b. Site preparation and support facilities;
c. Excavation of contaminated materials;
d. Classification of contaminated materials;
e. Stabilization of contaminants;
f. Transport of contaminated materials to a licensed disposal area;
g. Disposal of the contaminated materials;
h. Grading, drainage improvements, and revegetation; and
i. Operation and maintenance, including an environmental monitoring program.

Development of a Stabilization Process. The primary contaminants found in the materials are the heavy metals. Chemical solidification/stabilization has been proposed as a treatment method for immobilization of heavy metals. Typical solidification/stabilization methods include cement or pozzolanic processes. Typical solidification/stabilization processes require the addition of 25 to 100 percent by weight of chemicals. In the case of contaminated soils, it may be necessary to add water to assure that the hydration reactions on which most processes depend actually occur. Wetland soil material will have extremely high concentrations of organic matter that may be difficult to stabilize. A variety of processes may be appropriate for the immobilization of metals in the excavated soils (EPA 1986a). Processes based on either cement or pozzolanic addition have been shown to immobilize heavy metals in a variety of matrices.

Appropriate regulatory agencies will be contacted to determine disposal requirements for the stabilized materials. The California waste classification system uses both a total and soluble criterion.. This complicates waste reclassification since it is doubtful that chemical stabilization/solidification processes can meet the total concentration criterion.

Discussions with State agencies reveal that it is possible to obtain variances (Tornatore 1988). Although formal delisting may not be required, it is believed that regulatory agencies will require some special handling of materials. For cost estimating purposes, it is assumed that Class III disposal will be acceptable. Concerns may be raised over the codisposal of the solidified/stabilized materials in a Class III environment.

Site Preparation and Support Facilities. See Alternative 3-3A.

Excavation. See Alternative 3-3A.

Stabilization of Contaminated Material. The contaminated soils will be stabilized by mixing with dry and possibly liquid reagents in a high powered pug mill or similar device. The proportions of reagents required to ensure stabilization will be determined in the previously described study to develop the stabilization process. After blending, the mixture is allowed to cure for at least 24 hrs before transport to the disposal facility.

Transport. See Alternative 3-3A.

Disposal. Stabilized materials will be transported to an existing Class III landfill for final disposal.

Grading and Revegetation. See Alternative 3-3A.

Operation and Maintenance of Remediation Area. See Alternative 3-3A.

6.3.5 Alternative 3-3D. Excavation/Immobilization/Disposal at Monofill on NWS Concord.

6.3.5.1 Description. An alternative to disposal in an licensed off-site facility is excavation, stabilization, and disposal in a monofill located on NWS Concord. The stabilization process effectively changes the hazardous nature of the contaminated material, permitting it to be handled as a non-hazardous material. The major components of this alternative include the development of an effective chemical stabilization process, classification of

the contaminated materials, excavation and stabilization of the excavated materials, transportation of the materials to a monofill constructed on NWS Concord, site grading and revegetation, construction of a monofill, an environmental monitoring program for RASS 3, and monitoring of the monofill. Quantities associated with implementation of Alternative 3-3D are presented in Table A.22.

6.3.5.2 Implementation. The major steps in implementing Alternative 3-3D are:

a. Development of a stabilization process;
b. Site preparation and support facilities;
c. Excavation of contaminated materials;
d. Classification of contaminated materials;
e. Stabilization of excavated soils;
f. Construction of a monofill;
g. Transport of solidified/stabilized materials to the monofill;
h. Disposal of the solidified/stabilized materials;
i. Grading, drainage improvements, and revegetation;
j. Operation and maintenance, including an environmental monitoring program for RASS 3;
k. Operation and maintenance of the monofill.

Development of a Stabilization Process. See Alternative 3-3C.

Site Preparation and Support Facilities. See Alternative 3-3A.

Excavation. See Alternative 3-3A.

Stabilization of Contaminated Material. See Alternative 3-3C.

Construction of a Monofill. A monofill would be constructed on NWS Concord. The facility would be constructed in accordance with State and Federal requirements. The site has not been selected; however, several candidate sites were investigated by WES (Lutton et al 1987). Because of concerns over the long term durability of the solidified/stabilized soils, the monofill would be constructed to meet Class I engineering standards. Note that Lutton

et al (1987) found that none of the available monofill sites on NWS Concord meet the State of California siting requirements for a Class I landfill. The solidification/stabilization process, combined with an engineered monofill constructed to Class I engineering requirements will provide a long term secure environment for the treated soils.

The rational for applying Class I or RCRA requirements to a non-hazardous material include extra protection of ground water, long term stability of the treated soils, and generation of a conservative cost estimate for alternative comparison. It is anticipated that the monofill will include a double liner, leachate collection and treatment system, leak detection system, and a RCRA type cap; however, final design features would be coordinated with the appropriate State and Federal agencies. Anticipated design features are illustrated on Plate 6.2. The monofill will require approximately 11 acres for active disposal operations plus a 250 ft. buffer zone.

Transport. See Alternative 3-3A.

Disposal of Stabilized Soils. Solidified/stabilized soils and Class III materials excavated from the remediation area would be spread in 6-9 in. lifts and compacted. Compaction requirements would be determined by a geotechnical design to ensure that adequate strength is developed to support the cap and overlying materials. Consideration may be given to using the monofill for surface construction; however, close coordination with State and Federal agencies would be required to determine restrictions on joint land use. Following completion of the remediation activities, the solidified/stabilized soils would be covered with a cap meeting Class I or RCRA requirements. Property records would be annotated to clearly delineate the location of the monofill. Deed restrictions would be used to further protect against accidental disturbance of the monofill.

Grading and Revegetation. See Alternative 3-3A.

Operation and Maintenance of Remediation Area. See Alternative 3-3A.

Operation and Maintenance of Monofill. Alternative 1-3D requires long term operation and maintenance of the monofill. Operation and maintenance activities will be conducted in accordance with State and Federal requirements.

6.3.6 Alternative 3-3E. Excavation/Soil Washing/Disposal at Existing Landfills.

6.3.6.1 Description. An alternative to disposal in an existing licensed Class I facility is excavation, soil washing, and disposal in an off-site Class III disposal facility. The soil washing process effectively changes the hazardous nature of the contaminated material, permitting it to be handled as a non-hazardous material. The major components of this alternative include the development of an effective soil washing process, testing of the contaminated materials, excavation and treatment of the excavated materials, transportation of the contaminated materials to an appropriate off-site disposal area, site grading, and revegetation, and an environmental monitoring program. Quantities associated with implementation of Alternative 3-3E are presented in Table A.20.

6.3.6.2 Implementation. The major steps in implementing Alternative 3-3E are:

a. Development of a soil washing process;
b. Site preparation and support facilities;
c. Excavation of contaminated materials;
d. Classification of contaminated materials;
e. Treatment of contaminated materials;
f. Transport of decontaminated materials to a licensed disposal area;
g. Transport of residual sludges and spent liquors;
h. Disposal of the decontaminated materials;
i. Disposal of residual sludges and spent liquors;
j. Grading and Revegetation; and
k. Operation and maintenance, including an environmental monitoring program for RASS 3.

Development of a Soil Washing Process. The primary contaminants found in RASS 3 are the heavy metals. Laboratory and pilot scale tests will be

required to determine the appropriate chemicals for washing of the contaminated soil materials. Such a study should be used to define the unit processes required and their operational parameters, including the required reagents and concentrations, temperatures, flows, volumes, etc. Actual materials from RASS 3 should be collected for these studies. Appropriate regulatory agencies will be contacted to determine disposal requirements for the decontaminated materials. Although formal delisting may not be required, it is believed that regulatory agencies will require some special handling of materials. For cost estimating purposes, it is assumed that Class III disposal of the decontaminated soils will be acceptable. Soil washing technology is somewhat conceptual and presents a high risk of failure. It should also be noted that soil washing does not destroy the heavy metals, but simply removes them from the soil and concentrates them into a reduced volume of sludge. It is estimated that the volume of sludge will be twenty percent of the volume of treated soil.

Site Preparation and Support Facilities. See Alternative 3-3A. In addition, a soil treatment system would be constructed. The soil treatment system would be designed on the basis of the pilot treatment study discussed above, but for this feasibility analysis, it is assumed that the system will consist of three series upflow column reactors capable of washing 300 cubic yards of contaminated soil per day. The first column would wash the soil with an aqueous surfactant, the next column in the series would apply an acid solution, and the final column in the series would apply a caustic solution to neutralize the materials leaving the second column. The system would include the necessary chemical mix tanks, pipes, valves, pumps, solids conveyors, and instrumentation and control systems. Most if not all of the systems components should be skid mounted to ease installation and increase the possible salvage value. The entire facility could be installed in a tension-fabric structure erected over an asphalt concrete pad underlain by a synthetic membrane with low permeability. Pilot studies may indicate that a simpler system would be sufficient for adequate treatment.

Excavation. See Alternative 3-3A.

Classification of Materials. See Alternative 3-3A.

Treatment of Contaminated Soils. The contaminated soils will be treated in the soil washing system. This work includes conveyance of the excavated materials from the storage structure to the treatment plant, treatment of the contaminated soils, and treatment/recycle/disposal of the spent washing reagents. The contaminated washing reagents will be shipped off-site for disposal in a Class I disposal facility. The possibility of recycling reagents to the greatest extent possible will be investigated during the pilot study. Since the spent reagents will be liquids, they will be chemically solidified/stabilized prior to disposal.

Transport of Treated Soils. Assuming that the soil washing process works, the treated soils could be handled as a "clean soil material" without special restrictions. However, for planning purposes, it is assumed that the treated soils can be handled as a Class III material. Decontaminated soils would be transported to the monofill in lined and covered trucks.

Transport of Residual Sludges. Residual sludges and spent liquors from the soil washing process will be transported to an existing Class I disposal facility using either truck or rail transportation. Trucks or rail cars would be lined and covered.

Disposal of Decontaminated Soils. Decontaminated materials will be transported to a Class III landfill for final disposal.

Disposal of Residual Sludges. Residual sludges and spent soil washing liquors will be disposed of in existing Class I disposal facilities.

Grading and Revegetation. See Alternative 3-3A.

Operation and Maintenance of Remediation Area. See Alternative 3-3A.

6.3.7 Alternative 3-3F. Excavation/Soil Washing/Disposal at Monofill on NWS Concord.

6.3.7.1 Description. An alternative to disposal in an existing licensed Class III disposal facility is excavation, soil washing, and disposal in a

Class III disposal facility located on NWS Concord. The soil washing process effectively changes the hazardous nature of the contaminated material, pe - mitting it to be handled as a non-hazardous material. The major components of this alternative include the development of an effective soil washing process, classification of the contaminated materials, excavation and treatment of the excavated materials, transportation of the contaminated materials to an appropriate disposal area, backfilling of excavated areas, site grading and revegetation, construction of a monofill, and an environmental monitoring program. Quantities associated with implementation of Alternative 3-3F are presented in Table A.21.

6.3.7.2 Implementation. The major steps in implementing Alternative 3-3F are:

a. Development of a soil washing process;
b. Site preparation and support facilities;
c. Excavation of contaminated materials;
d. Classification of contaminated materials;
e. Treatment of contaminated materials;
f. Construction of a monofill on NWS Concord;
g. Transport of decontaminated materials to the disposal area;
h. Transport of residual sludges and spent liquors;
i. Disposal of the decontaminated materials;
j. Disposal of residual sludges and spent liquors;
k. Grading and revegetation;
l. Operation and maintenance, including an environmental monitoring program for the remediation area; and
m. Operation and maintenance of the monofill.

Development of a Soil Washing Process. See Alternative 3-3E.

Site Preparation and Support Facilities. See Alternative 3-3E.

Construction of a Monofill. A monofill would be constructed on NWS Concord. The facility would be constructed in accordance with State and Federal requirements. The site has not been selected; however, several candidate sites were investigated by WES (Lutton et al 1987). If successful, the soil

washing process would remove the contaminants from the soils and concentrate them in residual sludges. Although it is conceivable that the soil washing process could produce a "clean" soil suitable for unrestricted use, for purposes of this FS it is assumed that a monofill for disposal of the treated soils would be constructed to meet Class III engineering standards. The monofill will require approximately 11 acres for active disposal operations plus a 250 ft. buffer zone.

Excavation of Contaminated Soils. See Alternative 3-3A.

Classification of Contaminated Soils. See Alternative 3-3A.

Treatment of Contaminated Material. See Alternative 3-3E.

Transport of Treated Soils. See Alternative 3-3E.

Transport of Residual Sludges. See Alternative 3-3E.

Disposal of Treated Soils. The soils would be transported to the monofill and placed in 6-9 in. lifts and compacted. Compaction requirements would be based on the characteristics of the treated soil and would be sufficient to provide support for overlying materials and a Class III cover.

Disposal of Residual Sludges. See Alternative 3-3E.

Grading and Revegetation. See Alternative 3-3A.

Operation and Maintenance of Remediation Area. See Alternative 3-3A.

Operation and Maintenance of Monofill. Alternative 3-3F requires long term operation and maintenance of the monofill. Operation and maintenance activities will be conducted in accordance with State and Federal requirements.

6.4 Remedial Action Subsite 4

6.4.1 Alternative 4-1. No Action.

6.4.1.1 Description. The no action alternative involves no active remediation activities. Soils containing high levels of heavy metals (exceeding TTLC/STLC criterion) and low soil pH values would be left in the "as is" condition. No environmental monitoring, other than the proposed surface water and ground water investigation (US Navy 1987) would be implemented. However, some miscellaneous activities would be implemented to provide minimum protection to the public health. Contaminated areas would be posted and property inventories would be appropriately annotated. Actual on site work would be limited to posting contaminated areas with appropriate warning signs. Quantities associated with implementation of Alternative 4-1 are presented in Table A.22.

6.4.1.2 Implementation. The major steps in implementing the no action alternative are:

a. Development of a contaminated area notification plan,
b. Posting the contaminated area with appropriate signs,
c. Annotation of property records, and
d. Annual inspection and maintenance of posted areas.

Development of Notification Plan. A detailed plan would be developed to ensure that adequate notification is provided to persons on NWS Concord and the general public concerning the presence of contamination on RASS 4.

Posting of Contaminated Areas. Contaminated areas would be posted with appropriate signs to warn both authorized personnel and potential trespassers of the presence of contamination.

Annotation of Property Records. Property records would be annotated to identify the location of the contaminated areas in RASS 4.

Annual Inspection and Maintenance. An annual inspection of RASS 4 would be conducted. Maintenance of warning signs would be conducted during this annual inspection.

6.4.2 Alternative 4-2. Environmental Monitoring

6.4.2.1 Description. The environmental monitoring alternative features the no action alternative, i.e., no active remedial action measures (except posting of contaminated areas) combined with environmental monitoring. Materials containing high levels of heavy metals and low pH values would be left in place. An environmental monitoring program would be implemented to periodically evaluate the environmental status of RASS 4. This monitoring program would be oriented to the analysis of environmental changes caused by migration of contaminants from the areas of high metal content. The environmental monitoring alternative (Alternative 4-2) would implement a program of surveillance and monitoring of soil and sediments, surface water, ground water, and biota on RASS 4. The environmental monitoring program is designed to emphasize either 1) those areas of environmental concern identified during the RI or 2) concerns raised by State regulatory agencies. Monitoring would be conducted in two phases.

Phase 1 sampling emphasizes the collection of data on the characteristics of the soil and sediments, surface water, and ground water located on RASS 4 and also implements a program of plant and vegetation observation. The Phase 1 sampling program would be conducted annually during the first five years following implementation of this alternative. Assuming no adverse impacts are identified that would necessitate implementation of an active remedy, Phase 1 sampling would be conducted every five years thereafter. This five year increment is consistent with the five year review required by SARA.

Phase 1. Soil and Sediment Sampling. Surface soil samples from the 0 to 12 in. depth would be collected and analyzed for arsenic, cadmium, copper, lead, selenium, and zinc. Sampling locations would correspond as closely as possible to those locations sampled by Lee et al. (1986). Additional samples would be collected over the remainder of the RASS in the most probable direction of contaminant migration. Soil metal concentrations would be compared to

those of previous samples, thus allowing an evaluation of the potential for contaminant migration and adverse impacts on the public health and the environment. For planning purposes, four soil samples would be collected on RASS 4 during each sampling episode.

Phase 1. Surface Water. Surface water samples would be collected at three locations in the creek and wetlands adjacent to RASS 4, two reference areas (BK 1331 and BK 1333) where biomonitoring was previously conducted, and a third reference area upstream of RASS 4. Water samples would be collected following a period of rainfall. Each sample would be analyzed for total and dissolved arsenic, cadmium, copper, lead, selenium, and zinc to evaluate the mobility of both bound and soluble metals.

Phase 1. Ground Water. Ground water samples would be collected from three monitoring wells. Samples would be analyzed for both total and dissolved arsenic, cadmium, copper, lead, selenium, and zinc.

Phase 1. Wildlife Observation. Observation of wildlife would be conducted once annually. Permanent transects would be established.

Phase 1. Vegetation Observation. Observations of vegetation would be conducted twice annually. Permanent transects would be established.

Phase 1. Site Conditions. Observations of general site conditions would be conducted.

Phase 2 sampling is oriented towards the evaluation of animal and plant populations on the RASS. Phase 2 monitoring for RASS 4 includes: clam bioaccumulation studies, vegetation bioaccumulation studies, and earthworm bioaccumulation studies.

Phase 2. Clam Bioaccumulation. Clam bioaccumulation studies would be conducted at the six locations selected for surface water monitoring.

Phase 2. Vegetation Bioaccumulation. Samples of vegetation would be collected to evaluate trends of heavy metal uptake. The number of samples would

be based on the number of soil samples collected in the Phase I sampling program. For planning purposes, it is assumed that four samples of vegetation would be collected during each sampling episode.

Phase 2.: Earthworm Bioaccumulation. Earthworm bioaccumulation studies would be conducted to evaluate trends in heavy metal release through the biological pathway. For planning purposes, it is assumed that bioaccumulation studies would be conducted on four soil samples.

A report would be prepared describing the results of sampling and making recommendations for additional monitoring of remedial actions. The report will also contain an assessment of physical changes in the contaminated areas, i.e., natural improvement or degradation in habitats, man-made alterations, etc. Quantities associated with implementation of Alternative 4-2 are presented in Table A.23.

6.4.2.2 Implementation. The major steps required for implementing this alternative are:

a. Design of a detailed sampling and analysis program,
b. Development of action levels and associated responses,
c. Conduct of a systematic sampling and analysis program, and
d. Implementation of additional remedial actions as required.

Detailed Sampling and Analysis Plan. A detailed sampling and analysis plan will be developed for the RASS. At a minimum, this plan will include a detailed schedule of sampling times, locations, procedures, and analyses. The plan would be prepared to meet the current requirements of regulatory agencies for the preparation of such plans. The plan would also include a detailed Quality Assurance Project Plan (QAPP) and Site Safety Plan (SSP).

The sampling and analysis program to be developed by this plan is generally described below.

Development of Action Levels. One of the purposes of environmental monitoring is to identify the need for additional positive actions for site remediation. A precursor to this activity is the development of action levels and

associated responses. A detailed plan would be developed to identify action levels and remedial actions that will be triggered if the action levels are exceeded.

Systematic Sampling and Analysis. The requirements of the detailed sampling and analysis plan would be implemented.

Implementation of Active Remedial Actions. If triggered by the results of environmental monitoring, active remedial action measures would be executed.

6.4.3 Alternative 4-3A. Excavation/Disposal at Existing Landfills

6.4.3.1 Description. The objective of Alternative 4-3A is to remove the contaminated material from active migration pathways and to dispose of them in an acceptable manner. The excavation and disposal in existing landfills option consists of excavating contaminated materials followed by disposal at an appropriately permitted existing disposal facility. Appropriate facilities willing to take each class of contaminated materials have been located and are presented in Table 5.1. The primary means of transportation for planning purposes will be in lined and covered dump trucks or rail cars. The excavation would be regraded and revegetated. The major components of this alternative consists of the excavation of soils in which the metal content exceeds the TTLC/STLC criterion, transportation of contaminated materials to an existing disposal facility, disposal of contaminated materials, lining of low pH soils, regrading and revegetation, and an environmental monitoring program. Quantities for major tasks associated with implementation of Alternative 4-3A are presented in Table A.24.

6.4.3.2 Implementation. The major steps in implementing the excavation and off-site disposal alternative are:

a. Site preparation and support facilities;
b. Excavation of contaminated materials;
c. Classification of contaminated materials;
d. Transport of contaminated materials to a licensed disposal area;
e. Disposal of the contaminated materials;

f. Grading and revegetation; and

g. Operation and maintenance

Site Preparation and Support Facilities. RASS 4 would be prepared for remedial construction activities by performing a detailed ground survey and constructing access roads, haul roads, and parking areas. An equipment/personnel decontamination area would be constructed near the entrance to RASS 4. This facility would be equipped with a high-pressure spray washer. Cleaning water would be collected and either treated or shipped off site if required. Trailers would be brought to the site to provide space for offices, locker rooms, laboratory and storage. Portable chemical toilets would be used to satisfy sanitary requiements.

Excavation. Approximately 0.56 acres of soil containing high levels (exceeding TTLC/STLC criterion) will be excavated to a depth of 1 ft. An additional 0.31 acres containing soils with a pH less than 5.5 would be treated with lime. Excavated soils will be transported to a temporary storage and classification facility.

The major concerns are the health and safety aspects associated with the excavation of contaminated materials. The primary concerns include the health and safety aspects of excavating contaminated materials and the load bearing capacity of the materials being excavated. In addition, extreme care must be taken to ensure that those areas not subject to active remediation are not disturbed unnecessarily.

The primary hazard to workers performing the excavation of contaminated materials will be through skin contact and inhalation of dusts containing contaminants. Workers may require respiratory protection from fugitive dust.

Materials Classification. The decision rules described in section 3.4.3.4 require excavation of Class I materials only. Therefore, materials classification will be evaluated during concept design. If proven to be economically advantageous, a materials classification scheme will be implemented. A facility will be constructed for classification of the excavated materials to ensure that they are routed to the most economical disposal facility, while

ensuring that the disposal facility selected provides for adequate environmental protection. Materials would be classified as Class I, Class II, o Class III. Classification will be in accordance with the standards of the California Department of Health Services and the Regional Water Quality Control Board. The exact basis of classification has not been determined. Materials would be excavated and stockpiled at the classification facility pending the results of TTLC/STLC testing. In addition, soils left in place would be treated to ensure removal in accordance with the remediation decision rules.

Transport of Contaminated Materials. Excavated materials would be transported to the appropriate disposal site in lined and covered trucks or rail cars. Trucks are assumed to have an 18 cubic yard capacity. Rail cars are assumed to have a 64 cubic yard capacity. Liners and covers are required to prevent loss of contaminated materials during transport. State and Federal transportation requirements would dictate the manner in which the soils containing high levels of heavy metals are shipped, including the size of trucks and the loads that can be carried. An additional requirement is the no free liquids regulation implemented under RCRA. Trucks would be decontaminated after loading and prior to leaving the contaminated areas.

Contaminated Material Disposal. Class I, Class II, and Class III landfills (Table 5.1) have been identified that can accept the contaminated materials. Materials will be handled in accordance with the requirements of each landfill.

Grading and Revegetation. The site will be regraded to approximate existing contours. Limited backfilling with top soil may be required. Revegetation will be mechanized to the greatest extent possible; however, some hand work may be required. Fill material, provided it is topsoil, should have adequate organic matter and other nutrients essential for plant growth. However, soil amendments such as natural fertilizers (e.g. cow manure) or commercial fertilizers and mulch may have to be added and mixed with the fill material.

Operation and Maintenance. The operation and maintenance requirements associated with the active remediation implemented under Alternative 4-3A are minimal. The maintenance program will be conducted for five years. Maintenance

will consist of an annual inspection and implementation of required corrective actions to ensure that the grading and revegetation are successful. Particular attention will be given to erosion control and vegetation colonization. Operations will include a 30 year program of environmental monitoring (described in Alternative 4-2). Environmental monitoring program will also include an evaluation of those contaminated areas not selected for active remediation at this time. If, after 5 years, monitoring indicates that there is no adverse impact to the public health or environment, intensive operation and maintenance activities will be discontinued after five years. However, a site status review will be conducted every five years.

6.4.4 Alternative 4-3C. Excavation/Immobilization/Disposal at Existing Landfills

6.4.4.1 Description. An alternative to disposal in an existing licensed Class I disposal facility is excavation, stabilization, and disposal in an existing Class III disposal facility. This process effectively changes the hazardous nature of the material, permitting it to be handled as a non-hazardous material. The major components of this alternative include the development of an effective chemical stabilization process, excavation of contaminated materials, classification of materials, stabilization of the excavated materials, transportation of the stabilized materials to an existing Class III disposal facility disposal of stabilized materials, liming low pH areas, site grading and revegetation, and an environmental monitoring program. Quantities associated with implementation of Alternative 4-3C are presented in Table A.25.

6.4.4.2 Implementation. The major steps in implementing Alternative 4-3C are:

a. Development of a stabilization process;
b. Site preparation and support facilities;
c. Excavation of contaminated materials;
d. Classification of contaminated materials;
e. Stabilization of contaminants;
f. Transport of contaminated materials to a licensed disposal area;
g. Disposal of the contaminated materials;

h. Backfilling excavated areas with clean material;

i. Liming areas with low soil pH;

j. Grading and revegetation; and

k. Operation and maintenance.

Development of a Stabilization Process. The primary contaminants found in the contaminated materials or RASS 4 are the heavy metals. Chemical solidification/stabilization has been proposed as a treatment method for immobilization of heavy metals. Arsenic, however, has proven to be difficult to immobilize. Typical solidification/stabilization methods include cement or pozzolanic processes. Typical solidification/stabilization processes require the addition of 25 to 100 percent by weight of binder. In the case of contaminated soils, it may be necessary to add water to assure that the hydration reactions occur. A variety of processes may be appropriate for the immobilization of metals in soils (USEPA 1986a). Processes based on either cement, pozzolan and/or proprietary chemical addition have been shown to immobilize heavy metals in a variety of matrices. Appropriate regulatory agencies will be contacted to determine disposal requirements for the stabilized materials. The California waste classification system uses both a total and soluble criterion. This complicates waste reclassification since it is doubtful that chemical solidification/stabilization processes can meet the total concentration criterion. Discussions will State agencies reveal that it is possible to obtain variances and special waste designations (Tornatore 1988). Although formal delisting may not be required, it is believed that regulatory agencies will require some special handling of materials. For cost estimating purposes, it is assumed that Class III disposal will be acceptable. Concerns may be raised over the codisposal of the solidified/stabilized materials in a Class III environment.

Site Preparation and Support Facilities. See Alternative 4-3A.

Excavation. See Alternative 4-3A.

Stabilization of Contaminated Material. Excavated soils will be stabilized by mixing with dry and possibly liquid reagents in a high powered pug mill or similar device. The proportions of reagents required to ensure stabilization

will be determined in the previously described study to develop the stabilization process. After blending, the mixture is allowed to cure for at least 24 hrs before transport to the final disposal area.

Transport of Stabilized Materials. See Alternative 4-3A. Transportation would be limited to trucks.

Disposal of Stabilized Materials. Stabilized materials will be transported to an existing Class III landfill for final disposal.

Grading and Revegetation. See Alternative 4-3A.

Operation and Maintenance of On Site Facilities. See Alternative 4-3A.

6.4.5 Alternative 4-3D. Excavation/Immobilization/Disposal at Monofill on NWS Concord.

6.4.5.1 Description. An alternative to disposal in an existing licensed disposal facility is excavation, stabilization, and disposal in a monofill located on NWS Concord. The stabilization process effectively changes the hazardous nature of the contaminated material, permitting it to be handled as a non-hazardous material. The major components of this alternative include the development of an effective chemical stabilization process, classification of the contaminated materials, excavation and stabilization of the excavated materials, transportation of the stabilized materials to a monofill on NWS Concord, disposal of stabilized materials, site grading and revegetation, construction of a monofill, an environmental monitoring program for RASS 4, and monitoring of the monofill. Quantities associated with implementation of Alternative 4-3D are presented in Table A.26.

6.4.5.2 Implementation. The major steps in implementing Alternative 4-3D are:

a. Development of a stabilization process;
b. Site preparation and support facilities;
c. Excavation of contaminated materials;
d. Classification of contaminated materials;

e. Stabilization of excavated soils;

f. Construction of monofill;

g. Transport of solidified/stabilized materials to the monofill;

h. Disposal of the solidified/stabilized materials;

i. Grading and revegetation;

j. Operation and maintenance, including an environmental monitoring program on RASS 4; and

k. Operation and maintenance of the monofill.

Development of a Stabilization Process. See Alternative 4-3C.

Site Preparation and Support Facilities. See Alternative 4-3A.

Excavation. See Alternative 4-3A.

Stabilization of Contaminated Material. See Alternative 4-3C.

Construction of a Monofill. A monofill would be constructed on NWS Concord. The facility would be constructed in accordance with State and Federal requirements. The site has not been selected; however, several candidate site were investigated by WES (Lutton et al 1987). Because of concerns over the long term durability of the solidified/stabilized soils, the monofill would be constructed to meet Class I engineering standards. Note that Lutton et al (1987) found that none of the available monofill sites on NWS Concord meet the State of California siting requirements for a Class I landfill. The solidification/stabilization process, combined with an engineered monofill constructed to Class I engineering requirements will provide a long term secure environment for the treated soils.

The rational for applying Class I or RCRA requirements to a non-hazardous material include extra protection of ground water, long term stability of the treated soils, and generation of a conservative cost estimate for alternative comparison. It is anticipated that the monofill will include a double liner, leachate collection and treatment system, leak detection system, and a RCRA type cap; however, final design features would be coordinated with the appropriate State and Federal agencies. Anticipated design features are

illustrated on Plate 6.2. The monofill will require approximately 8 acres for active disposal plus a 250 ft. buffer zone.

Transport. See Alternative 4-3A.

Disposal of Stabilized Soils. Solidified/stabilized soils and Class III materials excavated from the remediation area would be spread in 6-9 in. lifts and compacted. Compaction requirements would be determined by a geotechnical design to ensure that adequate strength is developed to support the cap and overlying materials. Consideration may be given to using the monofill for surface construction; however, close coordination with State and Federal agencies would be required to determine restrictions on joint land use. Following completion of the remediation activities, the solidified/stabilized soils would be covered with a cap meeting Class I or RCRA requirements. Property records would be annotated to clearly delineate the location of the monofill. Deed restrictions would be used to further protect against accidental disturbance of the monofill.

Backfilling of Excavated Areas. See Alternative 4-3A.

Grading and Revegetation. See Alternative 4-3A.

Operation and Maintenance of Remediation Area. See Alternative 4-3A.

Operation and Maintenance of Monofill. Alternative 1-3D requires long term operation and maintenance of the monofill. Operation and maintenance activities will be conducted in accordance with State and Federal requirements.

6.4.6 Alternative 4-3E. Excavation/Soil Washing/Disposal at Existing Landfills.

6.4.6.1 Description. An alternative to disposal in a licensed Class I disposal facility is excavation, soil washing, and disposal in an existing Class III disposal facility. The soil washing process effectively changes the hazardous nature of the contaminated material, permitting it to be handled as a non-hazardous material. The major components of this alternative include

the development of an effective soil washing process, testing of the contaminated materials, excavation and treatment of the excavated materials, transportation of the contaminated materials to an appropriate off-site disposal area, backfilling of excavated areas, site grading, site revegetation, and site restoration. Quantities associated with implementation of Alternative 4-3E are presented in Table A.27.

6.4.6.2 Implementation. The major steps in implementing Alternative 4-3E are:

a. Development of a soil washing process;
b. Site preparation and support facilities;
c. Excavation of contaminated materials;
d. Classification of contaminated materials;
e. Treatment of contaminated materials;
f. Transport of decontaminated materials to a licensed disposal area;
g. Transport of residual sludges and spent liquors;
h. Disposal of the decontaminated materials;
i. Disposal of residual sludges and spent liquors;
j. Grading and revegetation; and
k. Operation and maintenance, including an environmental monitoring program for RASS 4.

Development of a Soil Washing Process. The primary contaminants found in the materials are the toxic metals and arsenic. Laboratory and pilot scale tests will be required to determine the appropriate chemicals for washing of the contaminated soil materials. Such a study should be used to define the unit processes required and their operational parameters, including the required reagents and concentrations, temperatures, flows, volumes, etc. Actual materials from RASS 4 should be collected for these studies. Appropriate regulatory agencies will be contacted to determine disposal requirements for the decontaminated materials. Although formal delisting may not be required, it is believed that regulatory agencies will require some special handling of materials. For cost estimating purposes, it is assumed that Class III disposal will be acceptable. Soil washing technology is somewhat conceptual and presents a high risk of failure. It should also be noted that soil washing does not destroy the heavy metals, but simply removes them from the soil and

concentrates them into a reduced volume of sludge. It is estimated that the volume of sludge will be twenty percent of the volume of treated soil.

Site Preparation and Support Facilities. See Alternative 4-3A. In addition, a soil treatment system would be constructed. The soil treatment system would be designed on the basis of the pilot treatment study discussed above, but for this feasibility analysis, it is assumed that the system will consist of three series upflow column reactors capable of washing 300 cubic yards of contaminated soil per day. The first column would wash the soil with an aqueous surfactant, the next column in the series would apply an acid solution, and the final column in the series would apply a caustic solution to neutralize the materials leaving the second column. The system would include the necessary chemical mix tanks, pipes, valves, pumps, solids conveyors, and instrumentation and control systems. Most if not all of the systems components should be skid mounted to ease installation and increase the possible salvage value. The entire facility could be installed in a tension-fabric structure erected over an asphalt concrete pad underlain by a synthetic membrane with low permeability. Pilot studies may indicate that a simpler system would be sufficient for adequate treatment.

Excavation. See Alternative 4-3A.

Classification of Materials. See Alternative 4-3A.

Treatment of Contaminated Soils. The contaminated soils will be treated in the soil washing system. This work includes conveyance of the excavated materials from the storage structure to the treatment plant, treatment of the contaminated soils, and treatment/recycle/disposal of the spent washing reagents. The contaminated washing reagents will be shipped off-site for disposal in a Class I disposal facility. The possibility of recycling reagents to the greatest extent possible will be investigated during the pilot study. Since the spent reagents will be liquids, they will be chemically solidified/stabilized prior to disposal.

Transport of Treated Soils. Assuming that the soil washing process works, the treated soils could be handled as a "clean soil material" without special

restrictions. However, for planning purposes, it is assumed that the treated soils can be handled as a Class III material. Decontaminated soils would be transported to the monofill in lined and covered trucks.

Transport of Residual Sludges. Residual sludges and spent liquors from the soil washing process will be transported to an existing Class I disposal facility using either truck or rail transportation. Trucks or rail cars would be lined and covered.

Disposal of Treated Soils. Decontaminated materials will be transported to a Class III landfill for final disposal.

Disposal of Residual Sludges. Residual sludges and spent soil washing liquors will be disposed of in existing Class I disposal facilities.

Grading and Revegetation. See Alternative 4-3A.

Operation and Maintenance of Remediation Area. See Alternative 4-3A.

6.4.7 Alternative 4-3F. Excavation/Soil Washing/Disposal at Monofill on NWS Concord.

6.4.7.1 Description. An alternative to disposal in an existing licensed Class III disposal facility is excavation, soil washing, and disposal in a Class III disposal facility located on NWS Concord. The soil washing process effectively changes the hazardous nature of the contaminated material, permitting it to be handled as a non-hazardous material. The major components of this alternative include the development of an effective soil washing process, classification of the contaminated materials, excavation and treatment of the excavated materials, transportation of the contaminated materials to an appropriate disposal area, backfilling of excavated areas, site grading and revegetation, construction of a monofill, and an environmental monitoring program. Quantities associated with implementation of Alternative 4-3F are presented in Table A.28.

6.4.7.2 Implementation. The major steps in implementing Alternative 4-3F are:

a. Development of a soil washing process;
b. Site preparation and support facilities;
c. Excavation of contaminated materials;
d. Classification of contaminated materials;
e. Treatment of contaminated materials;
f. Construction of a monofill on NWS Concord;
g. Transport of decontaminated materials to the disposal area;
h. Transport of residual sludges and spent liquors;
i. Disposal of the decontaminated materials;
j. Disposal of residual sludges and spent liquors;
k. Grading, and Revegetation;
l. Operation and maintenance, including an environmental monitoring program for the remediation area; and
m. Operation and maintenance of the monofill.

Development of a Soil Washing Process. See Alternative 4-3E.

Site Preparation and Support Facilities. See Alternative 4-3E.

Construction of a Monofill. A monofill would be constructed on NWS Concord. The facility would be constructed in accordance with State and Federal requirements. The site has not been selected; however, several candidate site were investigated by WES (Lutton et al 1987). If successful, the soil washing process would remove the contaminants from the soils and concentrate them in residual sludges. Although it is conceivable that the soil washing process could produce a "clean" soil suitable for unrestricted use, for purposes of this FS it is assumed that a monofill for disposal of the treated soils would be constructed to meet Class III engineering standards. The monofill will require approximately 7 acres for active disposal plus a 250 ft. buffer zone.

Excavation of Contaminated Soils. See Alternative 4-3C.

Classification of Contaminated Soils. See Alternative 4-3A.

Treatment of Contaminated Soils. See Alternative 4-3E.

Transport of Treated Soils. See Alternative 4-3E.

Transport of Residual Sludges. See Alternative 4-3E.

Disposal of Treated Soils. The soils would be transported to the monofill and placed in 6-9 in. lifts and compacted. Compaction requirements would be based on the characteristics of the treated soil and would be sufficient to provide support for overlying materials and a Class III cover.

Disposal of Residual Sludges. See Alternative 4-3E.

Grading and Revegetation. See Alternative 4-3A.

Operation and Maintenance of Remediation Area. See Alternative 4-3A.

Operation and Maintenance of Monofill. Alternative 1-3F requires long term operation and maintenance of the monofill. Operation and maintenance activities will be conducted in accordance with State and Federal requirements.

6.4.8 Alternative 4-4A. Source Isolation/Soil Cap

6.4.8.1 Description. This alternative examines the use of a topsoil/vegetative cover to reduce the possibility of erosion and direct contact with the contaminated soil materials. The contaminated soil material located on the various sites will not be removed. A natural soil cover would be placed over the contaminated areas. The primary components of this alternative include the placement of a soil cover, grading, and revegetation of the sites. The quantities of materials required to implement this alternative are listed in Table A.29.

6.4.8.2 Implementation. The major steps in implementing this alternative are:

a. Site preparation and support facilities;
b. Placement of cover, site grading, and revegetation; and

c. Site maintenance and monitoring.

Site Preparation and Support Facilities. The various sites would be prepared for construction activities by performing a detailed ground survey of each site and constructing temporary access roads, haul roads, and parking areas. An equipment/personnel decontamination area would be constructed near the entrance to each site. This facility would be equipped with a high-pressure spray washer. Cleaning water would be collected and either treated or shipped off site if required. Trailers would be brought to the site as required to provide space for offices, locker rooms, laboratories, and storage as required. Portable chemical toilets would be used to satisfy sanitary requirements.

Placement of Cover, Site Grading, and Revegetation. The various sites would be covered with 2 feet of compacted select fill material and graded to promote runoff. Following grading and compacting, 2 feet of topsoil would be placed uniformly over the sites to facilitate the establishment of vegetation. The addition of 2 feet of top soil will ensure the long term success of the proposed shallow rooted vegetation. The topsoil would be minimally compacted. After topsoil placement is complete, a mixture of shallow-rooted grasses would be established to stabilize the surface against erosion, improve the appearance of the sites, and reduce maintenance requirements.

Site Maintenance and Monitoring. The operation and maintenance program for Alternative 4-4A will be conducted in perpetuity. Maintenance will consist of an annual inspection and implementation of required corrective actions to ensure that the grading and revegetation efforts are successful. Particular attention will be given to erosion control. Maintenance will be more intensive during the first 5 years or until the vegetative covers are established. Maintenance of the vegetative ground cover (e.g., mowing, seeding and mulching, replacing soil, and fertilizing) may be required to prevent exposure of contaminated materials. Control of deep rooted vegetation would be controlled. Operation will include a program of environmental monitoring including surface water, sediment, ground water, and biota (to include wildlife) (described in Alternative 4-2). Environmental monitoring will include an evaluation of those contaminated areas not selected for remediation.

6.4.9 Alternative 4-4B. Source Isolation/RCRA Cap

6.4.9.1 Description of Alternative 4-4B. This alternative examines the use of a multilayered cover (RCRA cap) to reduce the possibility of erosion and direct contact with the contaminated soil material. This alternative consists of raising the surface of the sites and regrading to provide a base for a RCRA cap design. The RCRA cap will include a 2 ft thick impermeable (10^{-7}) clay layer, a 12 inch drainage layer, a 20 mil synthetic membrane with bedding, and a 2 ft layer of topsoil. Finally, the cover will be graded and revegetated. A cross section of the RCRA cap is illustrated in Plate 5.3. The quantities of materials required to implement this alternative are presented in Table A.30.

After the sites have been prepared for cap construction, a 2 ft thick low permeability layer would be placed directly on the prepared surface. It would be placed and compacted to form a continuous blanket with a hydraulic conductivity less than 10^{-1} cm/s. The drainage layer of compacted sand (hydraulic conductivity greater than 10^{-7} cm/2) would be placed on top of the synthetic membrane. The drainage layer would be designed so that collected water flows freely in the lateral direction to minimize the head on the low permeability layer. A 2 ft layer of topsoil would be placed over the drainage layer. This thickness of topsoil would ensure that the impermeable layer and drainage layer are protected from desiccation and other surface activities. The top-soil would also optimize conditions for the establishment of a vegetative cover designed to: stabilize the soil against wind and water erosion; reduce runoff through interception, infiltration, uptake and transpiration; protect the drainage and impermeable layer; improve the appearance of the sites; and reduce long term maintenance requirements.

Construction of the cover would be sequenced to reduce environmental impacts, particularly in the wetland areas. Appropriate erosion control procedures would be implemented during construction to minimize off site migration of contaminants. Cover materials would be transported to the site by truck. Once at the sites, materials would be spread and compacted by conventional earthwork equipment. It is assumed for cost purposes that suitable cover materials can be located within 25 miles of the NWS Concord. The cover

materials would be spread in loose lifts 6 to 8 inches deep and compacted to the required density. The sites will be revegetated with plant species suitable for the area. Salt tolerant species will be selected for use in the former wetland areas.

6.4.9.2 Implementation of Alternative 4-4B. The major steps in implementing this alternative include:

a. Site preparation and support facilities;
b. Filling and grading the sites;
c. Construction of the multilayered cover;
d. Site maintenance and monitoring.

Site Preparation and Support Facilities. Site preparation and support facilities would be similar to those described in Alternative 4-4A. Additional geotechnical studies will be conducted to determine the stability of the proposed cover under seismic forces and long term erosion. This will be particularly important in the wetland areas.

Filling and Grading of the Sites. Prior to constructing the RCRA cap, the sites will be graded and filled with compacted select material to provide a suitable structural base for the cap.

Construction of Multilayered Cover. A multilayered cover would be used to reduce surface water infiltration into the disposed materials and to minimize erosion and direct contact with contaminated soil material. The RCRA cap includes four functionally distinct layers. A low permeability layer of clay would be placed over the surface of the sites to minimize surface water infiltration. A synthetic membrane and appropriate bedding would be placed over the synthetic membrane to facilitate drainage of water reaching the surface of the synthetic membrane. The upper most layer of the cover would consist of topsoil supporting shallow rooted revegetation as a protective covering.

Site Maintenance and Monitoring. See Alternative 4-4A.

7.0 DETAILED EVALUATION OF REMEDIAL ALTERNATIVES

This section presents a detailed evaluation of each of the alternatives that passed the initial screening process described in Section 5. The detailed evaluation of alternatives discusses the desirability of implementing an alternative in terms of technical feasibility, environmental considerations, institutional considerations, public health considerations, and cost. The detailed analysis of each alternative includes the following (NCP Section 300.68(h)).

a. Refinement and detailed description of the alternative, with emphasis on technology (Section 6);

b. Evaluation in terms of engineering implementability, reliability, and constructability;

c. An assessment of the extent to which the alternative is expected to effectively prevent, mitigate or minimize threats to and provide adequate protection of public health and the environment;

d. An analysis of the adverse environmental impacts, methods for mitigating these impacts, and costs of mitigation; and

e. Detailed cost estimate including operation and maintenance cost distributed over time.

The detailed description of each alternative (including the no-action alternative) emphasizing the key features of each alternative has been provided in Section 6. The remainder of the required evaluation factors will be discussed in this section.

Table 7.1 presents the criteria used for detailed evaluation of the alternatives. The detailed evaluation for each alternative in terms of technical feasibility, environmental considerations, institutional concerns and

Table 7.1

Detailed Evaluation Criteria

- Technical Feasibility
  - Performance
  - Reliability
  - Implementability
  - Safety
  - Level of Remediation Achievable

- Environmental Considerations
  - Beneficial effects
  - Adverse effects

- Institutional Considerations
  - Conformance to the ARAR
  - Permitting requirements
  - Legal constraints, if any
  - Cultural Resources

- Public Health Considerations
  - Minimization of exposure
  - Minimization of chemical releases
  - Releases that will not be minimized
  - Exposures during remedial action
  - Exposures after remedial action

- Cost
  - Capital cost
  - Operation and maintenance costs
  - Present worth cost

costs are discussed in the text specifically mentioned and summarized in the associated tables.

The results of the detailed evaluation for each alternative with respect to each of the criterion listed in Table 7.1 are expressed in a rating system utilizing the terms high, moderate, and low.

High. A high rating indicates that the alternative promotes the intent of the criteria and meets or exceeds the remedial objectives, for the most part.

Moderate. A moderate rating indicates that the alternative neither promotes nor adversely affects the intent of the criterion. With a moderate rating, however, the alternative does remediate the problem to an appreciable extent even though it does not meet all the objectives.

Low. A low rating indicates that the alternative does not promote the criterion and does not meet the remedial objectives for the most part.

7.1 Technical Feasibility of Alternatives

This section presents the technical evaluation of all the remedial alternatives considered for each RASS. Each alternative was evaluated relative to performance, reliability, implementability, safety, and level of remediation.

Performance is the ability to effectively perform the intended functions. Performance of a remedial alternative is evaluated based on two factors; effectiveness and useful life. Effectiveness refers to the degree to which an action will prevent or minimize substantial damage to public health, welfare, or the environment. The useful life is the length of time the level of effectiveness can be maintained.

Reliability of a remedial action is evaluated in terms of operation and maintenance requirements and demonstrated performance at similar sites. Evaluation of operation and maintenance includes availability of labor and materials and the frequency and complexity of the operation and maintenance needs. Technologies requiring frequent or complex operation and maintenance

activities are considered less reliable. The evaluation of demonstrated performance includes an estimate of the probability of failure for each component of the remedial alternative and the demonstrated performance and use of the remedial technologies at other hazardous waste sites.

Implementability is the relative ease of installation or constructability of the remedial technology and the time required to achieve a given level of response. Constructability is the ability to actually build, construct, or implement the remedial technology given the conditions at the site and external to the site which would affect implementing the alternative. Two measures of time were addressed: the time it takes to implement a remedy and the time it takes to realize beneficial effects.

Safety includes short-term and long-term threats to the safety of nearby communities and environments as well as those to workers during implementation such as potential for fire, explosion, and exposure to chemicals.

The level of remediation or the reduction in levels of contamination attainable by each alternative to attain or exceed relevant or applicable standards will be discussed.

A summary of the technical feasibility evaluation is presented in Tables following the discussion of all alternatives for an individual RASS.

7.1.1 Remedial Action Subsite 1

7.1.1.1 Alternative 1-1. No Action

Performance. The no action alternative would provide notice of the contaminated areas in RASS 1 and would reduce somewhat the threat of human contact with the surface soils containing high levels of heavy metals and arsenic. It may not be very effective since people may ignore the warning signs. The warning signs will have to be occasionally maintained and replaced since they may be knocked down, lost, stolen, or damaged. The warning signs provide no protection to the on-site flora and fauna. The major impacts of the no action alternative are described in Lee et al. (1986). The no action

alternative would leave soils containing high levels of heavy metals in the environment. The no action alternative performance rating is low.

Reliability. The maintenance of the warning signs requires no special operation and maintenance activities. Failure of Alternative 1-1 would result in an increased probability of persons coming into contact with the contaminated materials. Failure of the property record annotation system could result in the unknowing development of the contaminated areas with the resultant increased possibility of exposure and spread of contamination. The reliability rating is moderate.

Long term operation and maintenance tasks for Alternative 1-1 include the following.

a. Annual notification plan update;
b. Annual site inspections;
c. Maintenance of signs; and
d. Annual site status report.

Implementability. Since no major construction is anticipated, no special implementation problems are anticipated in implementation of Alternative 1-1. However, regulatory concerns and the degree of public acceptance may preclude implementation of the no action alternative. Implementation of Alternative 1-1 would require no additional detailed studies prior to final design. Implementation would require six months with beneficial results obtained shortly thereafter. The overall implementability rating is high.

Safety. There are no additional safety risks to on- or off-site personnel resulting from the implementation of Alternative 1-1. A safety risk to trespassers and the environment will remain. However, persons entering the posted areas should wear protective clothing and respiratory protection to eliminate the risk of exposure to the contaminants. The overall safety rating is moderate.

Level of Remediation Achievable. No remediation is achieved by this alternative. The primary receptors, on-site wildlife and vegetation, are not protected by Alternative 1-1. The Level of Remediation is low.

Overall Technical Feasibility Rating. Based on the evaluations presented above, the overall technical feasibility rating of Alternative 1-1 is low

7.1.1.2 Alternative 1-2. Environmental Monitoring

Performance. Alternative 1-2 does not meet the selected environmental protection goals and site specific criteria and offers no additional positive protection beyond the no action alternative. However, Alternative 1-2 will allow the continued characterization of the environment in the contaminated and adjacent areas. In addition, implementation of this alternative would document change in contaminant migration patterns. The overall performance rating is low.

Reliability. Alternative 1-2 is designed to allow the further identification of contaminant transport mechanisms and the quantification of environmental impacts. In addition, this alternative includes provisions for triggering future positive remedial action, if deemed necessary. Failure of this alternative would eliminate the ability to track changes in contaminant migration patterns. Since this alternative provides no initial positive environmental protection, its success or failure would result in the same impacts as the no action alternative. Data collection for the environmental monitoring program would be very reliable; however, data interpretation and analysis would be less reliable and subject to uncertainty. The reliability rating for this alternative is moderate.

Long term operation and maintenance tasks for Alternative 1-2 include the following.

a. Annual notification plan update;
b. Annual site inspections;
c. Maintenance of signs;
d. Environmental monitoring;
e. Annual site status report; and
f. Periodic reports describing the results of environmental monitoring.

Implementability. Since no major construction is anticipated, no special implementation problems are anticipated in implementation of Alternative 1-2. There will be problems associated with the interpretation of environmental data and the determination of action levels that would trigger the implementation of positive remedial action measures. These action levels must be quantified in the detailed implementation plan. Regulatory concerns and the degree of public acceptance may preclude implementation of the no action alternative. Implementation would require twelve months with beneficial results obtained shortly thereafter.

Implementation of Alternative 1-2 will require the following detailed studies prior to final design.

a. Development of a detailed sampling and analysis plan; and

b. Identification of appropriate action levels for implementing future remedial actions.

The overall implementability rating is high.

Safety. Minimal additional safety risks are associated with the implementation of Alternative 1-2. These risks are associated with the additional site monitoring which necessitates that personnel go into and adjacent to the contaminated areas. Persons entering the posted areas should wear protective clothing and respiratory protection to eliminate the risk of exposure to the contaminants. The additional risk is considered to be minimal because of the limited duration of site inspections. The overall safety rating is moderate.

Level of Remediation Achievable. No remediation is achieved by this alternative. The Level of Remediation is low.

Overall Technical Feasibility Rating. Based on the evaluations presented above, the overall technical feasibility rating of Alternative 1-2 is low.

7.1.1.3 Alternative 1-3A

Performance. Alternative 1-3A will be effective in meeting the environmental protection goals since excavation is a proven technology. Excavation can

easily be performed to depths below the anticipated level of contamination. Excavated materials can be classified with relative ease and the required clean up levels can be documented. The excavated materials will be transported by truck or rail to appropriate existing landfills. Wetland restoration would be implemented in accordance with a detailed restoration plan.

Alternative 1-3A provides for removal of substantial quantities of contaminated soil material from RASS 1 and is the most effective remedy for long term remediation of the contaminated areas. This alternative does not remove some of the contamination that has migrated from the area of initial discharge. This alternative can successfully address the first element of the environmental protection goals, i.e., "minimize or eliminate the continued release and potential release of hazardous substances." Short term impacts are minimized by the implementation of a wetland restoration program.

The performance rating of Alternative 1-3A is high.

Reliability. All of the technologies in Alternative 1-3A have been proven in similar site conditions. The only exception is the wetland restoration program. After the initial restoration program (5 years) there are no anticipated long term operation and maintenance activities that would be prone to fail. The potential for failure is essentially removed because most of the contamination is removed from the site. There is some potential that the contamination left in place will cause environmental problems; however, this possibility is addressed through implementation of the long term monitoring program.

Long term operation and maintenance requirements for Alternative 1-3A include the following.

a. Site maintenance for the first five years;
b. Environmental monitoring in accordance with Alternative 1-2; and
c. Annual reports.

The reliability rating of this alternative is high.

Implementability. Labor and materials are readily available for all elements of this alternative. Disposal facilities have been identified; however, the exact disposal location has not been selected. The time required for implementation of this alternative, other than wetland restoration, is eighteen months. Wetland restoration will be completed within five years.

The development of a detailed transportation plan will address public concerns over the transport of contaminated materials from NWS Concord to the selected disposal facility. This is not believed to have a significant impact on the implementability of the alternative and can be resolved in the concept design phase. However, time delays may be incurred. Transport by rail may be less controversial than truck transport and could be considered as an alternative.

Implementation of Alternative 1-3A will require the following detailed studies prior to final design.

a. Development of a safe method for excavating and transporting contaminated soils;

b. Confirmation of wetland excavation methods;

c. Finalization of locations for disposal;

d. Location of suitable backfill material;

e. Development of a detailed sampling and analysis plan; and

f. Identification of appropriate action levels for implementing future remedial actions.

The implementability rating of this alternative is moderate.

Safety. The only significant threats to safety are short-term exposure of on-site workers to the contaminated materials and heavy truck traffic through public right-of-way during transport of the contaminated materials to the disposal facilities. On-site workers can be protected from the contamination by implementation of appropriate personnel protection programs. Some safety problems will be caused by the off-site transport of a large volume of contaminated soils. Safety problems associated with the off-site transport of contaminated materials can be minimized by development of a detailed transportation plan during the concept development phase. Safety problems

associated with off-site transport would be further minimized if rail transport is selected. There are no long term threats to workers or near y facilities or communities associated with this alternative.

The safety rating of this alternative is high.

Level of Remediation Achievable. The level of remediation achievable by this alternative is high. Contaminated material would be removed from RASS 1 and disposed of in an existing Class I landfill. In addition, the wetland would be fully restored.

Implementation of the selected criteria is estimated to result in the removal and positive control of the following amounts of contamination.

Arsenic	51 percent	Zinc	28 percent
Cadmium	37 percent	Copper	50 percent
Lead	27 percent	Selenium	92 percent
Nickel	15 percent		

Overall Technical Feasibility Rating. Based on the evaluations presented above, the overall technical feasibility rating of Alternative 1-3A is high.

7.1.1.3 Alternative 1-3C

Performance. Alternative 1-3C will be effective in meeting the environmental protection goals since excavation is a proven technology. Excavation can easily be performed to depths below the anticipated level of contamination. Excavated materials can be classified with relative ease and the required clean up levels can be documented. The excavated materials will be stabilized and the contaminants would be immobilized in the soil mass using solidification/stabilization technology. The stabilized materials will be transported to an existing Class III disposal facility. Wetland restoration would be implemented in accordance with a detailed restoration plan.

Alternative 1-3C provides for removal of contaminated soil material from RASS 1 and is an effective remedy for long term remediation of the contaminated areas. This alternative does not remove some of the contamination that has migrated from the area of the initial discharge of contaminants into surrounding areas. This alternative can successfully address the first element of the environmental protection goals, i.e., "minimize or eliminate the continued release and potential release of hazardous substances." Short term impacts will be minimized by implementation of a wetland restoration program.

The performance rating of Alternative 1-3C is high.

Reliability. All of the technologies in Alternative 1-3C have been proven in similar site conditions. The only exception is the wetland restoration program. After the initial restoration program (5 years) there is no anticipated long term operation and maintenance activities that would be prone to fail. The potential for failure is essentially removed because the contamination in the excavated soil is immobilized in the soil mass and removed from the site. There is some potential that the contamination left in place will cause environmental problems; however, this possibility is addressed through implementation of the long term monitoring program.

The long term stability of the immobilized contaminants may be of some concern. This is especially true in the case where the material may be co-disposed in a municipal type (Class III) landfill. The acidic environment of such landfills may adversely affect the solidified/stabilized materials and increase release of the heavy metals. Additional testing may be required during the development of the stabilization process to document the long term durability of the treated soils.

Long term operation and maintenance requirements for Alternative 1-3C include the following.

a. Site maintenance for the first five years;
b. Environmental monitoring in accordance with Alternative 1-2; and
c. Periodic reports for five years.

The reliability rating of this alternative is moderate.

Implementability. Labor and materials are readily available for all elements of this alternative. Several potential disposal areas have been identified within an acceptable distance from the site.

The only remaining problem areas are the development of a transportation plan that will address public concerns over the transport of contaminated materials through the public right-of-way and the development of an appropriate stabilization process. Since the contaminated materials are rendered non-hazardous by the stabilization process, development of an acceptable transportation plan is not believed to have a significant impact on the implementability of the alternative and can be resolved in the concept design phase. Development of a stabilization process will be accomplished during the concept development phase. A variety of commercially available processes may be applicable to the contaminants found on RASS 1. Development of an acceptable process is not expected to present a significant impediment to implementation of this alternative; however, the use of the TTLC/STLC evaluation procedure tends to complicate the development of an acceptable solidification/stabilization process. Process development will be coordinated with appropriate regulatory agencies, which may cause delays in project approval.

Implementation of Alternative 1-3C will require thirty months. Wetland restoration would be completed within five years.

Implementation of Alternative 1-3C will require the following detailed studies prior to final design.

a. Development of a safe method for excavating and transporting contaminated soils;

b. Confirmation of wetland excavation methods;

c. Finalization of locations for disposal;

d. Location of suitable backfill material;

e. Development of contaminant immobilization process;

f. Development of a detailed sampling and analysis plan; and

g. Identification of appropriate action levels for implementing future remedial actions.

The implementability rating of this alternative is high.

Safety. The only significant threats to safety are short-term exposure of on-site workers to the contaminated materials and heavy truck traffic on NWS Concord and in nearby communities during transport of the solidified/ stabilized materials to the disposal facility. On-site workers can be protected from the contamination by implementation of appropriate personnel protection programs. Safety problems associated with transport of contaminated and solidified/stabilized materials will be minimized by development of a detailed transportation plan during the concept development phase. There are no long term threats to workers or nearby facilities or communities associated with this alternative.

The safety rating of this alternative is high.

Level of Remediation Achievable. The level of remediation achievable by this alternative is high. Contaminated material would be removed from RASS 1, rendered non-hazardous by the stabilization process, and disposed of in an existing licensed disposal facility. In addition, the wetland would be fully restored.

Implementation of the selected criteria is estimated to result in the removal and positive control of the following amounts of contamination.

Arsenic	51 percent	Zinc	28 percent
Cadmium	37 percent	Copper	50 percent
Lead	27 percent	Selenium	92 percent
Nickel	15 percent		

Overall Technical Feasibility Rating. Based on the evaluations presented above, the overall technical feasibility rating of Alternative 1-3C is high.

7.1.1.4 Alternative 1-3D

Performance. Alternative 1-3D will be effective in meeting the environmental protection goals since excavation is a proven technology. Excavation can easily be performed to depths below the anticipated level of contamination. Excavated materials can be classified with relative ease and the required clean up levels can be documented. The excavated materials will be stabilized and the contaminants would be immobilized in the soil mass by the solidification/stabilization process. The stabilized materials will be transported to monofill constructed on NWS Concord. Wetland restoration would be implemented in accordance with a detailed restoration plan.

Alternative 1-3D provides for removal of contaminated soil material from RASS 1 and is an effective remedy for long term remediation of the contaminated areas. This alternative does not remove some of the contamination that has migrated from the area of the initial discharge of contaminants into surrounding areas. This alternative can successfully address the first element of the environmental protection goals, i.e., "minimize or eliminate the continued release and potential release of hazardous substances."

The performance rating of Alternative 1-3D is high.

Reliability. All of the technologies in Alternative 1-3D have been proven in similar site conditions. The only exceptions are the wetland restoration program and the solidification/stabilization process. After the initial restoration program (5 years) there is no anticipated long term operation and maintenance activities that would be prone to fail. The potential for failure is minimized because the contamination is immobilized in the soil mass and removed from the site. There is some potential that the contamination left in place will cause environmental problems; however, this possibility is addressed through implementation of the long term monitoring program.

The long term stability of the immobilized contaminants is a primary concern. The possibility of failure of this alternative is minimized by the disposal of

the solidified/stabilized materials in a landfill constructed to Class I standards. Although none of the monofill sites evaluated on NWS Concord (Lutton et al 1987) meet Class I facility siting requirements, the engineering features of a Class I facility combined with the limited mobility of the contaminants of concern should provide for secure disposal of the solidified/stabilized soils. Additional testing may be required during the development of the stabilization process to document the long term durability of the treated soils.

Long term operation and maintenance requirements for Alternative 1-3D include the following.

a. Site maintenance for the first five years;

b. Environmental monitoring in accordance with Alternative 1-2 for first five years;

c. Maintenance and monitoring of the monofill; and

d. Annual reports for five years on area of remediation and at least thirty years on the monofill facility.

The reliability rating of this alternative is moderate.

Implementability. Labor and materials are readily available for all elements of this alternative. Several potential disposal areas have been identified on NWS Concord. Final site selection would be made in the concept design phase. Final site selection and facility design will be coordinated with appropriate regulatory agencies. Extensive coordination requirements may delay completion of the alternative.

The only remaining problem areas are the development of a transportation plan that will address public concerns over the transport of contaminated and solidified/stabilized materials on NWS Concord and the development of an appropriate stabilization process. Since the contaminated materials are rendered non-hazardous by the stabilization process, development of an acceptable transportation plan is not believed to have a significant impact on the implementability of the alternative and can be resolved in the concept design phase. Development of a stabilization process will be accomplished during the concept development phase. A variety of commercially available processes may

be applicable to the contaminants found on RASS 1. Development of an acceptable process is not expected to present a significant impediment to imple en-tation of this alternative; however, the use of the TTLC/STLC evaluation procedure tends to complicate the development of an acceptable solidification/stabilization process. Process development will be coordinated with appropriate regulatory agencies, which may cause delays in project approval.

Implementation of Alternative 1-3D will require the following detailed studies prior to final design.

a. Development of a safe method for excavating and transporting contaminated soils;

b. Confirmation of wetland excavation methods;

c. Selection of location for monofill;

d. Location of suitable backfill material;

e. Development of contaminant immobilization process;

f. Development of a detailed sampling and analysis plan; and

g. Identification of appropriate action levels for implementing future remedial actions.

The time required for implementation of this alternative, other than wetland restoration, is thirty months. Wetland restoration will be completed within five years.

The implementability rating of this alternative is moderate.

<u>Safety</u>. The only significant threats to safety are short-term exposure of on-site workers to the contaminated materials and heavy truck traffic on NWS Concord during transport of the solidified/stabilized materials to the monofill. On-site workers can be protected from the contamination by implementation of appropriate personnel protection programs. Safety problems associated with transport of contaminated and solidified/stabilized materials will be minimized by development of a detailed transportation plan during the concept development phase. There are no long term threats to workers or nearby facilities or communities associated with this alternative.

The safety rating of this alternative is high.

Level of Remediation Achievable. The level of remediation achievable by this alternative is high. Contaminated material would be removed from RASS 1, rendered non-hazardous by the stabilization process, and disposed of in an engineered monofill facility. In addition, the wetland would be fully restored.

Implementation of the selected criteria is estimated to result in the removal and positive control of the following amounts of contamination.

Arsenic	51 percent	Zinc	28 percent
Cadmium	37 percent	Copper	50 percent
Lead	27 percent	Selenium	92 percent
Nickel	15 percent		

Overall Technical Feasibility Rating. Based on the evaluations presented above, the overall technical feasibility rating of Alternative 1-3D is high.

7.1.1.5 Alternative 1-3E

Performance. Alternative 1-3E will be effective in meeting the environmental protection goals since excavation is a proven technology. Excavation can easily be performed to depths below the anticipated level of contamination. Excavated materials can be classified with relative ease and the required clean up levels can be documented. The excavated materials will be treated in a soil washing process and contaminants will be removed from the soil. The decontaminated materials will be transported to an existing Class III disposal facility. The contaminants will be concentrated in the reagents used for soil washing. Residual contaminants will be disposed of in existing Class I facilities. Wetland restoration would be implemented in accordance with a detailed restoration plan.

Alternative 1-3E provides for removal of contaminated soil material from RASS 1 and is an effective remedy for long term remediation of the contaminated areas. This alternative does not remove some of the contamination that

has migrated from the area of the initial discharge. This alternative can successfully address the first element of the environmental protection go ls, i.e., "minimize or eliminate the continued release and potential release of hazardous substances." However, the contamination is concentrated in sludges, which will require disposal in a Class I facility. The volume of these sludges is expected to be approximately twenty percent of the volume of soil.

The performance rating of Alternative 1-3E is high.

Reliability. The primary technology used in Alternative 1-3E, soil washing, has not been proven on the field scale. Reliability of this alternative would be improved by conduct of extensive laboratory and pilot scale testing. The effectiveness of the soil washing process can be demonstrated through testing after treatment. If contamination remains, the materials can be directed to Class I or Class II disposal sites rather than a Class III site. In addition, there may be some concern about the ability to restore wetlands on a large scale. After the initial restoration program (5 years) there is no anticipated long term operation and maintenance activities that would be prone to fail. There is some potential that the contamination left in place will cause environmental problems; however, this possibility is addressed through implementation of the long term monitoring program.

Long term operation and maintenance requirements for Alternative 1-3E include the following.

a. Site maintenance for the first five years;

b. Environmental monitoring in accordance with Alternative 1-2 for first five years; and

c. Annual reports for five years.

The reliability rating of this alternative is moderate.

Implementability. Labor and materials for most elements of this alternative are readily available. The major exception to this is the availability of a large scale soil washing facility. Since this technology has not been

widely implemented on a large scale, the soil washing facility would probably have to be custom designed and constructed. Potential disposal areas have been identified within a reasonable distance from the site.

The only remaining problem areas are the development of a detailed transportation plan that will address public concerns over the transport of contaminated and decontaminated materials on NWS Concord and through the public right-of-way. Since the contaminated materials would be rendered non-hazardous by the soil washing process, development of an acceptable transportation plan is not believed to have a significant impact on the implementability of the alternative and can be resolved in the concept design phase. Development of a soil washing process will be accomplished during the concept design phase. Since there are no large scale applications of this process, development of an acceptable process may present a significant impediment to timely implementation of this alternative. It is anticipated that extensive laboratory and pilot scale testing will be required to verify the soil washing process. Coordination and approval of regulatory agencies will also be required. As a result, delays in project completion may be anticipated.

Implementation of Alternative 1-3E will require the following detailed studies prior to final design.

a. Development of a safe method for excavating and transporting contaminated soils;

b. Confirmation of wetland excavation methods;

c. Finalization of locations for disposal;

d. Location of suitable backfill material;

e. Development of a soil washing process;

f. Development of a detailed sampling and analysis plan; and

g. Identification of appropriate action levels for implementing future remedial actions.

The time required for implementation of this alternative, other than wetland restoration, is 36 months. Wetland restoration will be completed within five years.

The implementability rating of this alternative is moderate.

Safety. Significant threats to safety are short-term exposure of on-site workers to the contaminated materials, exposure to the safety problems associated with handling the chemical reagents used in the soil washing process, and heavy truck traffic on NWS Concord and the public rights-of-way during transport of the treated soils and residual sludges to the disposal areas. On-site workers can be protected from the contamination by implementation of appropriate personnel protection programs. Safety problems associated with transport of materials will be minimized by development of a detailed transportation plan during the concept development phase. There are no long term threats to workers or nearby facilities or communities associated with this alternative.

The safety rating of this alternative is moderate.

Level of Remediation Achievable. The level of remediation achievable by this alternative is high. Contaminated material would be removed from RASS 1, rendered non-hazardous by the soil washing process, and disposed of in an existing Class III disposal facility. A concentrated waste stream of contaminants would be produced that would require special treatment and handling, including disposal in an existing Class I disposal facility. The wetland would be fully restored.

Implementation of the selected criteria is estimated to result in the removal and positive control of the following amounts of contamination.

Arsenic	51 percent	Zinc	28 percent
Cadmium	37 percent	Copper	50 percent
Lead	27 percent	Selenium	92 percent
Nickel	15 percent		

Overall Technical Feasibility Rating. Based on the evaluations presented above, the overall technical feasibility rating of Alternative 1-3E is moderate.

7.1.1.6 Alternative 1-3F

Performance. Alternative 1-3F will be effective in meeting the environmental protection goals since excavation is a proven technology. Excavation can easily be performed to depths below the anticipated level of contamination. Excavated materials can be classified with relative ease and the required clean up levels can be documented. The excavated materials will be treated in a soil washing process and contaminants will be removed from the soil and concentrated in residual sludges. The decontaminated materials will be transported to an engineered Class III monofill constructed on NWS Concord. The contaminants will be concentrated in the reagents used for soil washing. Residual sludges will be disposed of in an existing Class I disposal facility. Wetland restoration would be implemented in accordance with a detailed restoration plan.

Alternative 1-3F provides for removal of contaminated soil material from RASS I and is an effective remedy for long term remediation of the contaminated areas. This alternative does not remove some of the contamination that has migrated from the area of the initial discharge of contaminants into surrounding areas. This alternative can successfully address the first element of the environmental protection goals, i.e., "minimize or eliminate the continued release and potential release of hazardous substances." However, the contamination is concentrated into residual sludges requiring disposal in an off-site Class I facility. The volume of these sludges is expected to be approximately twenty percent of the volume of soil.

The performance rating of Alternative 1-3F is high.

Reliability. The primary technology used in Alternative 1-3F, soil washing, has not been proven on the field scale. The reliability of this alternative would be improved by conduct of extensive laboratory and pilot scale testing. The effectiveness of the soil washing process can be demonstrated through testing after treatment. If contamination remains, the materials can be directed to Class I or Class II disposal sites rather than a Class III site.

In addition, there may be some concern about the ability to restore wetlands on a large scale. After the initial restoration program (5 years) there are no anticipated long term operation and maintenance activities that would be prone to fail. The potential for failure is essentially removed because the contamination is removed from the soil mass, concentrated in residual sludges, and removed from the site. There is some potential that the contamination left in place will cause environmental problems; however, this possibility is addressed through implementation of the long term monitoring program.

Long term operation and maintenance requirements for Alternative 1-3F include the following.

a. Site maintenance for the first five years;

b. Environmental monitoring in accordance with Alternative 1-2 for first five years.

c. Maintenance and monitoring of the monofill; and

d. Annual reports for five years on area of remediation and at least thirty years on on-site disposal facility.

The reliability rating of this alternative is moderate.

Implementability. Labor and materials for most elements of this alternative are readily available. The major exception to this is the availability of a large scale soil washing facility. Since this technology has not been implemented on a large scale, the soil washing facility would have to be custom designed and constructed. Potential disposal areas for the decontaminated soils have been identified on NWS Concord.

The only remaining problem areas are the development of a transportation plan that will address public concerns over the transport of contaminated and decontaminated soils on NWS Concord, development of a transportation plan for transport of residual sludges to an existing Class I disposal facility, and development of the soil washing process. Since the contaminated soils are rendered non-hazardous by the soil washing process, development of an acceptable onsite transportation plan is not believed to have a significant impact on the implementability of the alternative and can be resolved in the concept design phase. Development of a soil washing process will be accomplished

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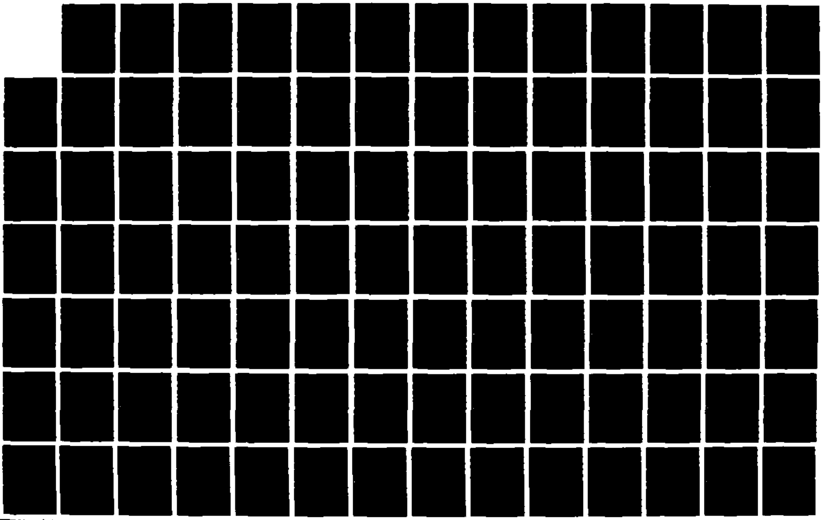

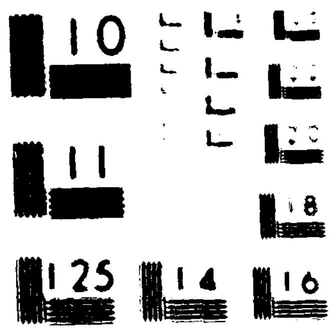
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during the concept development phase. Since there are no large scale applications of this process, development of an acceptable process may present a significant impediment to timely implementation of this alternative. It is anticipated that extensive laboratory and pilot scale testing will be required to verify the soil washing process. Coordination and approval of regulatory agencies will also be required. As a result, delays in project completion may be anticipated.

Implementation of Alternative 1-3F will require the following detailed studies prior to final design.

a. Development of a safe method for excavating and transporting contaminated soils;

b. Confirmation of wetland excavation methods;

c. Finalization of locations for disposal;

d. Location of suitable backfill material;

e. Development of a soil washing process;

f. Selection of a location for on-site landfill;

g. Development of a detailed sampling and analysis plan; and

h. Identification of appropriate action levels for implementing future remedial actions.

The time required for implementation of this alternative, other than wetland restoration, is 36 months. Wetland restoration will be completed within five years.

The implementability rating of this alternative is moderate.

Safety. Significant threats to safety are short-term exposure of on-site workers to the contaminated materials, exposure to the safety problems associated with handling the chemical reagents used in the soil washing process, and heavy truck traffic on NWS Concord and the public rights-of-way during transport of the contaminated materials to the disposal areas. On-site workers can be protected from the contamination by implementation of appropriate personnel protection programs. Safety problems associated with transport of contaminated materials will be minimized by development of a detailed transportation plan during the concept development phase. There are no long

term threats to workers of safety [illegible] this alternative.

The safety rating of this alternative is [illegible]

Level of Remediation Achievable. [illegible] alternative is high. Contaminated materials [illegible] rendered non-hazardous by the soil washing process [illegible] Class III on-site disposal facility. [illegible] nants would be produced that would require special treatment [illegible] disposal in an off-site Class I disposal facility. [illegible] restored.

Implementation of the selected criteria is estimated [illegible] and positive control of the following amounts of contamination [illegible]

Arsenic	51 percent	[illegible]	[illegible] percent
Cadmium	37 percent	Copper	[illegible] percent
Lead	27 percent	Selenium	[illegible] percent
Nickel	15 percent		

Overall Technical Feasibility Rating. Based on the evaluation [illegible] above, the overall technical feasibility rating of Alternative [illegible] moderate.

7.1.1.7 Summary of Technical Feasibility Analysis for RASS [illegible] Alternatives

A detailed summary of the technical feasibility analysis for the alternative remedial actions considered for RASS 1 is presented in Table [illegible]. An overall summary is presented in Table 7.3.

Table 7.[illegible]

Summary of Technical Feasibility Evaluation for [illegible] Alternatives

Remedial Alternatives Remedial Alternative	Performance Effectiveness	Performance Useful Life	Reliability Operation and Maintenance Requirements	Reliability Potential Failure Modes
1-1: No Action	Moderate restriction of access	[illegible] 30 years	[illegible]	[illegible]
	Overall performance rating low		Overall reliability rating moderate	
1-2: Environmental Monitoring	Continued evaluation of environment.	30 years	Annual inspection and biannual environmental studies	Poor detection of "trigger" contaminant levels
	Overall performance rating low		Overall reliability rating moderate.	
1-3A: Excavation/Disposal At Existing Landfills/ Restoration	Highly effective, removes contaminated materials, restores wetlands.	Not applicable-waste removed	Continuous operation and maintenance during construction, post construction maintenance of wetland first five years, annual inspection and biannual environmental studies 30 years.	Failure of wetland restoration, failure of disposal site.
	Overall performance rating high.		Overall reliability rating high.	
1-3C: Excavation/ Immobilization/ Disposal At Existing Landfills/Restoration	Same as 1-3A except contaminants chemically immobilized prior to landfilling.	Same as 1-3A	Same as 1-3A	Same as 1-3A plus concerns about long term stability of chemical immobilization process.
	Overall performance rating high.		Overall reliability rating moderate.	
1-3D: Excavation/ Immobilization/ Disposal at Monofill on NWS Concord/ Restoration	Same as 1-3A except contaminants chemically immobilized prior to landfilling.	Same as 1-3A	Same as 1-3A	Same as 1-3C
	Overall performance rating high.		Overall reliability rating moderate.	
1-3E: Excavation/Soil Washing/Disposal At Existing Landfill/ Restoration	Same as 1-3A except contaminants removed and concentrated in waste side stream.	Same as 1-3A	Same as 1-3A	Same as 1-3A plus possibility that soil washing process will not be effective.
	Overall performance rating high.		Overall reliability rating moderate.	
1-3F: Excavation/Soil Washing/Disposal At Monofill on NWS Concord/ Restoration	Same as 1-3E except decontaminated soils disposed of on-site.	Same as 1-3A	Same as 1-3A	Same as 1-3E
	Overall performance rating high.		Overall reliability rating moderate.	

Table 7.2 (Continued)

Summary of Technical Feasibility Evaluation for RASS 1 Alternatives

Remedial Alternatives	Criterion			
	Implementability			
	Constructability		Time	
Remedial Alternatives	Site Conditions	Conditions External to Site	To Implement	To See Desired Results
1-1: No Action	Readily constructable.	Public and regulatory acceptance doubtful.	6 months	6 months
		Overall implementability rating high.		
1-2: Environmental Monitoring	Readily constructable.	Public and regulatory acceptance doubtful.	12 months	12 months
		Overall implementability rating high.		
1-3A: Excavation/Disposal At Existing Landfills/ Restoration	Readily constructable, soft soils may require scheduling during dry season.	Good, public concern about transport of large volumes of contaminated soils through communities.	18 months	60 months (wetland restoration)
		Overall implementability rating moderate.		
1-3C: Excavation/Immobilization/ Disposal At Existing Landfills/Restoration	Same as 1-3A.	Excellent, same as 1-3A except contaminant immobilization [illegible] opposition to off site transport	30 months	60 months (wetland restoration)
		Overall implementability rating [illegible]		
1-3D: Excavation/Immobilization/ Disposal At Monofill on NWS Concord/Restoration	Same as 1-3A plus [illegible] disposal site selection	Same as 1-3C [illegible] of off site transport	[illegible] months	60 months [illegible]
		[illegible]		
1-3E: Excavation/Soil Washing/ Disposal At Existing Landfill/Restoration	[illegible]	[illegible]	[illegible]	[illegible]
		[illegible]		
1-3F: [illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		[illegible]		

[illegible]		[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		[illegible]		
[illegible]	Environmental Monitoring	[illegible]	[illegible]	[illegible]
		Overall safety rating moderate.		
1-3A	Excavation/Disposal At Existing Landfills/ Restoration	Short-term: Potential exposure to contamination during excavation and transport operations. Long-term: None.	Short-term: Heavy truck traffic. Long-term: None	High
		Overall safety rating high.		
1-3C:	Excavation/ Immobilization/Disposal At Existing Landfills/ Restoration	Same as 1-3A.	Same as 1-3A	High
		Overall safety rating high.		
1-3D:	Excavation/ Immobilization/Disposal At Monofill on NWS Concord/Restoration	Same as 1-3A.	Same as 1-3A	High
		Overall safety rating high.		
1-3E:	Excavation/Soil Washing/ Disposal At Existing Landfill/Restoration	Short-term: Potential exposure to contaminated materials and hazardous chemicals used in soil washing process. Long-term: None.	Short-term: Heavy truck traffic and concentrated contaminants from soil washing process. Long-term: None	High
		Overall safety rating moderate.		
1-3F:	Excavation/Soil Washing/ Disposal At Monofill on NWS Concord/Restoration	Same as 1-3E.	Same as 1-3E	High
		Overall safety rating moderate.		

Table 7.3

Overall Summary of Technical Feasibility Evaluation for RASS 1 Alternatives

Alternative	Performance	Reliability	Implementability	Safety	Level of Remediation	Overall Technical Feasibility
1-1: No Action	Low	Moderate	High	Moderate	Low	Low
1-2: Environmental Monitoring	Low	Moderate	High	Moderate	Low	Low
1-3A: Excavation/Disposal At Existing Landfills/Restoration	High	High	Moderate	High	High	High
1-3C: Excavation/Immobilization/ Disposal At Existing Landfills/ Restoration	High	Moderate	Moderate	High	High	High
1-3D: Excavation/Immobilization/ Disposal At Monofill on NWS Concord/Restoration	High	Moderate	Moderate	High	High	High
1-3E: Excavation/Soil Washing/ Disposal At Existing Landfill/ Restoration	High	Moderate	Moderate	Moderate	High	Moderate
1-3F: Excavation/Soil Washing/ Disposal At Monofill on NWS Concord/Restoration	High	Moderate	Moderate	Moderate	High	Moderate

[illegible] Remedial Action Subsite 2

[illegible] Alternative 2-1: No Action

Performance. The no action alternative would provide notice of the contaminated areas in Subsite 2 and would reduce somewhat the threat of human contact with the surface soils containing high levels of heavy metals and arsenic. It may not be very effective since nature watchers and children may ignore the warning signs. The warning sign will have to be occasionally maintained and replaced since these may be knocked down, lost, stolen, or damaged. The warning signs provide no protection to the on-site flora and fauna. The major impacts of the no action alternative are described in Lee et al. (1986). The no action alternative would leave soils containing high levels of heavy metals in the environment. The no action alternative performance rating is low.

Reliability. The maintenance of the warning sign requires no special operation and maintenance activities. Failure of Alternative 2-1 would result in an increased probability of persons coming into contact with the contaminant materials. Failure of the property record annotation system could result in the unknowing development of the contaminated areas with the resultant increased probability of exposure and spread of contamination. The reliability rating is moderate.

Long term operation and maintenance tasks for Alternative 2-1 include the following:

a. Annual notification plan update;
b. Annual site inspections;
c. Maintenance of signs; and
d. Annual site status report.

Implementability. Since no major construction is anticipated, no special implementation problems are anticipated in implementation of Alternative 2-1. However, regulatory concerns and the degree of public acceptance may preclude implementation of the no action alternative. Implementation of Alternative 2-1 would require no additional detailed studies prior to final design.

Implementation would require six months with beneficial results obtained shortly thereafter. The overall implementability rating is high.

Safety. There are no additional safety risks to on- or off-site resulting from the implementation of Alternative 2-1. However, persons entering the posted areas should wear protective clothing and respiratory protection to eliminate the risk of exposure to the contaminants. The overall safety rating is moderate.

Level of Remediation Achievable. No remediation is achieved by this alternative. The primary receptors, on-site wildlife and vegetation, are not protected by Alternative 2-1. The Level of Remediation is low.

Overall Technical Feasibility Rating. Based on the evaluations presented above, the overall technical feasibility rating of Alternative 2-1 is low.

7.1.2.2 Alternative 2-2. Environmental Monitoring

Performance. Alternative 2-2 does not meet the selected environmental protection goals and site specific criteria and offers no additional positive protection beyond the no action alternative. However, Alternative 2-2 will allow the continued characterization of the environment in the contaminated and adjacent areas. In addition, implementation of this alternative would document change in contaminant migration patterns. The overall performance rating is low.

Reliability. Alternative 2-2 is designed to allow the further identification of contaminant transport mechanisms and the quantification of environmental impacts. In addition, this alternative includes provisions for triggering future positive remedial action, if deemed necessary. Failure of this alternative would eliminate the ability to track changes in contaminant migration patterns. Since this alternative provides no initial positive environmental protection, its success or failure would result in the same impacts as the no action alternative. Data collection for the environmental monitoring program would be very reliable; however, data interpretation and analysis would be

[illegible]

[illegible] following:

a. [illegible]

b. [illegible]

c. [illegible]

d. [illegible]

e. [illegible] and

[illegible] monitoring

[illegible] special [illegible] Alternative [illegible] environmental [illegible] trigger the implementa- [illegible] These action levels must be [illegible] Regulatory concerns and the [illegible] of the no action [illegible] months with beneficial [illegible] Alternative [illegible] will [illegible] final design.

- [illegible] sampling and analysis plan; and
- [illegible] levels for implementing future [illegible]

The overall implementability rating is high.

Safety. [illegible] are associated with the implementation of Alternative [illegible] These risks are associated with the additional site monitoring which [illegible] go into and adjacent to the contaminated areas. [illegible] areas should wear protective clothing and [illegible] to eliminate the risk of exposure to the contaminants. The additional risk is considered to be minimal because of the limited duration of site inspections. The overall safety rating is moderate.

Level of Remediation Achievable. No remediation is achieved by this alternative. The Level of Remediation is low.

Overall Technical Feasibility Rating. Based on the evaluations presented above, the overall technical feasibility rating of Alternative 2-2 is low.

7.1.2.3 Alternative 2-3A

Performance. Alternative 2-3A will be effective in meeting the environmental protection goals since excavation is a proven technology. Excavation can easily be performed to depths below the anticipated level of contamination. Excavated materials can be classified with relative ease and the required clean up levels can be documented. The excavated materials will be transported by truck or rail to appropriate existing landfills. Wetland restoration would be implemented in accordance with a detailed restoration plan.

Alternative 2-3A provides for removal of substantial quantities of contaminated soil material from RASS 2 and is the most effective remedy for long term remediation of the contaminated areas. This alternative does not remove some of the contamination that has migrated from the area of initial discharge. This alternative can successfully address the first element of the environmental protection goals, i.e., "minimize or eliminate the continued release and potential release of hazardous substances." Short term impacts are minimized by the implementation of a wetland restoration program.

The performance rating of Alternative 2-3A is high.

Reliability. All of the technologies in Alternative 2-3A have been proven in similar site conditions. The only exception is the wetland restoration program. After the initial restoration program (5 years) there are no anticipated long term operation and maintenance activities that would be prone to fail. The potential for failure is essentially removed because the contamination is removed from the site. There is some potential that the contamination left in place will cause environmental problems; however, this possibility is addressed through implementation of the long term monitoring program.

Long term operation and maintenance requirements for Alternative 2-3A include the following.

a. Site maintenance for the first five years;

b. Environmental monitoring in accordance with Alternative 2-2; and

c. Annual reports.

The reliability rating of this alternative is high

<u>Implementability</u>. Labor and materials are readily available for all elements of this alternative. Disposal facilities have been identified; however, the exact disposal location has not been selected. The time required for implementation of this alternative, other than wetland restoration, is eighteen months. Wetland restoration will be completed within five years.

The development of a detailed transportation plan will address public concerns over the transport of contaminated materials from NWS Concord to the selected disposal facility. This is not believe. to have a significant impact on the implementability of the alternative and can be resolved in the concept design phase. However, time delays may be incurred. Transport by rail may be less controversial than truck transport and could be considered as an alternative Regulatory input would be required in the development of the final transportation and disposal plan. Some project delays may occur.

Implementation of Alternative 2-3A will require the following detailed studies prior to final design.

a. Development of a safe method for excavating and transporting contaminated soils;

b. Confirmation of wetland excavation methods;

c. Finalization of locations for disposal;

d. Location of a suitable backfill material;

e. Development of a detailed sampling and analysis plan; and

f. Identification of appropriate action levels for implementing future remedial actions.

The implementability rating of this alternative is moderate.

Safety. The only significant threats [illegible] safety [illegible]

on-site workers to the contaminated [illegible] and [illegible]

public right-of-way during [illegible]

posal facilities. On-site workers [illegible]

implementation of appropriate [illegible]

associated with the off-site [illegible]

minimized by development of [illegible]

development phase. [illegible]

be further minimized [illegible]

threats to workers [illegible]

alternative.

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]
Cadmium	[illegible]	[illegible]	[illegible]
Lead	[illegible]	[illegible]	[illegible]
Nickel	[illegible]		

[illegible]

[illegible] Alternative [illegible]

[illegible]

clean up levels can be documented. The excavated material [illegible] be stabilized and the contaminants would be immobilized in the soil mass using solidification stabilization technology. The stabilized material [illegible] be transported to an existing [illegible] disposal facility. [illegible] would be implemented in accordance with a [illegible] on [illegible].

Alternative [illegible] provides for removal of contaminated soil [illegible] from [illegible] and is an effective remedy for long term [illegible] of the contaminated areas. This alternative does not remove some of the contamination that has migrated from the area [illegible] the [illegible] discharge of contaminants into surrounding areas. This alternative can successfully address the [illegible] element [illegible] environmental protection goals [illegible] the continued release and potential releases of hazardous substances. Short term impacts will be minimized by implementation of a [illegible] program.

The performance rating of Alternative [illegible] is high.

Reliability. All of the technologies in Alternative [illegible] have been proven [illegible] similar site conditions. The only exception is the wetland restoration program. After the initial restoration program [illegible] years, there are no anticipated long term operation and maintenance activities that would be prone to fail. The potential for failure is essentially removed because the contamination is immobilized in the soil mass and removed from the site. There is some potential that the contamination left in place will cause environmental problems; however, this possibility is addressed through implementation of the long term monitoring program.

The long term stability of the immobilized contaminants may be of some concern. This is especially true in the case where the material may be co-disposed in a municipal type (Class III) landfill. The acidic environment of such landfills may adversely affect the solidified stabilized materials and increase release of the heavy metals. Additional testing may be required during the development of the stabilization process to document the long term durability of the treated soils.

Long term operation and maintenance requirements for Alternative [illegible] include the following:

a. Site maintenance for the [illegible] years;

b. [illegible] monitoring [illegible]; and

c. [illegible] reports for [illegible] years.

The reliability rating of this alternative is moderate.

Implementability. Labor and materials are readily [illegible] of this alternative. [illegible] within an acceptable distance from the site.

The only remaining problem areas are the development of a transportation plan that will address public concerns over the transport of contaminated material through the public right of way and the development of an appropriate stabilization process. Since the contaminated material [illegible] by the stabilization process, development of an acceptable transportation plan is not believed to have a significant impact on the implementability of the alternative and can be resolved in the concept design phase. Development of a stabilization process will be accomplished during the concept development phase. A variety of commercially available processes may be applicable to the contaminants found in [illegible]. Development of an acceptable process is not expected to present a significant impediment to implementation of this alternative; however, the use of the [illegible] [illegible] to complicate the development of an acceptable [illegible] stabilization process. Process development will be coordinated with appropriate regulatory agencies, which may cause delays in project approval.

Implementation of Alternative [illegible] will require [illegible] months. [illegible] restoration would be completed within five years.

Implementation of Alternative [illegible] will require the following detailed studies prior to final design.

a. Development of a safe method for excavating and transporting contaminated soils;

b. Confirmation of wetland excavation methods;

c. Finalization of locations for disposal;

d. Location of suitable backfill material;

e. Development of a contaminant immobilization process;

f. Development of a detailed sampling and analysis plan; and

g. Identification of appropriate action levels for implementing future remedial actions.

The implementability rating of this alternative is moderate.

Safety. The only significant threats to safety are short-term exposure of on-site workers to the contaminated materials and heavy truck traffic on NWS Concord and in nearby communities during transport of the solidified/stabilized materials to the disposal facility. On-site workers can be protected from the contamination by implementation of appropriate personnel protection programs. Safety problems associated with transport of contaminated and solidified/stabilized materials will be minimized by development of a detailed transportation plan during the concept development phase. There are no long term threats to workers or nearby facilities or communities associated with this alternative.

The safety rating of this alternative is high.

Level of Remediation Achievable. The level of remediation achievable by this alternative is high. Contaminated material would be removed from PASS 2, rendered non-hazardous by the stabilization process, and disposed of in a licensed disposal facility. In addition, the wetland would be fully restored.

Implementation of the selected criteria is estimated to result in the positive control of the following amounts of contamination.

Arsenic	91 percent	Zinc	88 percent
Cadmium	84 percent	Copper	86 percent
Lead	92 percent	Selenium	75 percent
Nickel	94 percent		

Overall Technical Feasibility Rating. Based on the evaluations presented above, the overall technical feasibility rating of Alternative 2-3C is high.

7.1.2.4 Alternative 2-3D

Performance. Alternative 2-3D will be effective in meeting the environmental protection goals since excavation is a proven technology. Excavation can easily be performed to depths below the anticipated level of contamination. Excavated materials can be classified with relative ease and the required clean up levels can be documented. The excavated materials will be stabilized and the contaminants would be immobilized in the soil mass by the solidification/stabilization process. The stabilized materials will be transported to monofill constructed on NWS Concord. Wetland restoration would be implemented in accordance with a detailed restoration plan.

Alternative 2-3D provides for removal of contaminated soil material from RASS 2 and is an effective remedy for long term remediation of the contaminated areas. This alternative does not remove some of the contamination that has migrated from the area of the initial discharge of contaminants into surrounding areas. This alternative can successfully address the first element of the environmental protection goals, i.e., "minimize or eliminate the continued release and potential release of hazardous substances."

The performance rating of Alternative 2-3D is high.

Reliability. All of the technologies in Alternative 2-3D have been proven in similar site conditions. The only exceptions are the wetland restoration program and the solidification/stabilization process. After the initial restoration program (5 years) there is no anticipated long term operation and maintenance activities that would be prone to fail. The potential for failure is minimized because the contamination is immobilized in the soil mass and

removed from the site. There is some potential that the contamination left in place will cause environmental problems; however, this possibility is addressed through implementation of the long term monitoring program.

The long term stability of the immobilized contaminants is a primary concern. The possibility of failure of this alternative is minimized by the disposal of the solidified/stabilized materials in a landfill constructed to Class I Standards. None of the monofill sites evaluated on NWS Concord (Lutton et al 1987) meet Class I facility siting requirements; however, the engineering features of a Class I facility combined with the limited mobility of the contaminants of concern should provide for secure disposal of the solidified/stabilized soils. Additional testing may be required during the development of the stabilization process to document the long term durability of the treated soils.

Long term operation and maintenance requirements for Alternative 2-3D include the following.

a. Site maintenance for the first five years;

b. Environmental monitoring in accordance with Alternative 2-2 for first five years;

c. Maintenance and monitoring of the monofill; and

d. Annual reports for five years on area of remediation and at least thirty years on the monofill facility.

The reliability rating of this alternative is moderate.

<u>Implementability</u>. Labor and materials are readily available for all elements of this alternative. Several potential disposal areas have been identified on NWS Concord. Final site selection would be made in the concept design phase. Final site selection on facility design will be coordinated with appropriate regulatory agencies. Extensive coordination requirements may delay completion of the alternative.

The only remaining problem areas are the development of a transportation plan that will address public concerns over the transport of contaminated materials

on NWS Concord and the development of an appropriate stabilization process. Since the contaminated materials are rendered non-hazardous by the stabiliza- tion process, development of an acceptable transportation plan is not believed to have a significant impact on the implementability of the alternative and can be resolved in the concept design phase. Development of a stabilization process will be accomplished during the concept development phase. A variety of commercially available processes may be applicable to the contaminants found on RASS 2. Development of an acceptable process is not expected to present a significant impediment to implementation of this alternative, how- ever, the use of the TTLC/STLC evaluation procedure tends to complicate the development of an acceptable solidification/stabilization process. Process development will be coordinated with appropriate regulatory agencies, which may cause delays in project approval.

Implementation of Alternative 2-3D will require the following detailed studies prior to final design.

a. Development of a safe method for excavating and transporting contami- nated soils;

b. Confirmation of wetland excavation methods;

c. Selection of a location for the monofill;

d. Location of suitable backfill material;

e. Development of a contaminant immobilization process;

f. Development of a detailed sampling and analysis plan; and

g. Identification of appropriate action levels for implementing future remedial actions.

The time required for implementation of this alternative, other than wetland restoration, is thirty months. Wetland restoration will be completed within five years.

The implementability rating of this alternative is moderate.

<u>Safety</u>. The only significant threats to safety are short-term exposure of on-site workers to the contaminated materials and heavy truck traffic on NWS Concord during transport of the solidified/stabilized materials to the mono- fill. On-site workers can be protected from the contamination by

implementation of appropriate personnel protection programs. Safety problems associated with transport of contaminated and solidified/stabilized materials will be minimized by development of a detailed transportation plan during the concept development phase. There are no long term threats to workers or nearby facilities or communities associated with this alternative.

The safety rating of this alternative is high.

Level of Remediation Achievable. The level of remediation achievable by this alternative is high. Contaminated material would be removed from RASS 2, rendered non-hazardous by the stabilization process, and disposed of in an engineered monofill facility. In addition, the wetland would be fully restored.

Implementation of the selected criteria is estimated to result in the positive control of the following amounts of contamination.

Arsenic	91 percent	Zinc	88 percent
Cadmium	84 percent	Copper	86 percent
Lead	92 percent	Selenium	75 percent
Nickel	94 percent		

Overall Technical Feasibility Rating. Based on the evaluations presented above, the overall technical effectiveness rating of Alternative 2-3D is high.

7.1.2.5 Alternative 2-3E

Performance. Alternative 2-3E will be effective in meeting the environmental protection goals since excavation is a proven technology. Excavation can easily be performed to depths below the anticipated level of contamination. Excavated materials can be classified with relative ease and the required clean up levels can be documented. The excavated materials will be treated in a soil washing process and contaminants will be removed from the soil. The decontaminated materials will be transported to an existing Class III disposal facility. The contaminants will be concentrated in the reagents used for soil washing. Residual contaminants will be disposed of in existing Class I

facilities. Wetland restoration would be implemented in accordance with a detailed restoration plan.

Alternative 2-3E provides for removal of contaminated soil material from RASS 2 and is an effective remedy for long term remediation of the contaminated areas. This alternative does not remove some of the contamination that has migrated from the area of the initial discharge. This alternative can successfully address the first element of the environmental protection goals, i.e., "minimize or eliminate the continued release and potential release of hazardous substances." However, the contamination is concentrated in sludges and requires disposal in a Class I facility. The volume of these sludges is expected to be approximately twenty percent of the volume of soil.

The performance rating of Alternative 2-3E is high.

Reliability. The primary technology used in Alternative 2-3E, soil washing, has not been proven on the field scale. Reliability of this alternative would be improved by conduct of extensive laboratory and pilot scale testing. The effectiveness of the soil washing process can be demonstrated through testing after treatment. If contamination remains, the materials can be directed to Class I or Class II disposal sites rather than a Class III site. In addition, there may be some concern about the ability to restore wetlands on a large scale. After the initial restoration program (5 years) there is no anticipated long term operation and maintenance activities that would be prone to fail. There is some potential that the contamination left in place will cause environmental problems; however, this possibility is addressed through implementation of the long term monitoring program.

Long term operation and maintenance requirements for Alternative 2-3E include the following.

a. Site maintenance for the first five years;

b. Environmental monitoring in accordance with Alternative 2-2 for first five years; and

c. Annual reports for five years.

The reliability rating of this alternative is moderate.

Implementability. Labor and materials for most elements of this alternative are readily available. The major exception to this is the availability of a large scale soil washing facility. Since this technology has not been widely implemented on a large scale, the soil washing facility would probably have to be custom designed and constructed.

Potential disposal areas have been identified within a reasonable distance from the site.

The only remaining problem areas are the development of a detailed transportation plan that will address public concerns over the transport of contaminated and decontaminated materials on NWS Concord and through the public right-of-way and development of a soil washing process. Since the contaminated materials would be rendered non-hazardous by the soil washing process, development of an acceptable transportation plan is not believed to have a significant impact on the implementability of the alternative and can be resolved in the concept design phase. Development of a soil washing process will be accomplished during the concept development phase. Since there are no large scale applications of this process, development of an acceptable process may present a significant impediment to timely implementation of this alternative. It is anticipated that extensive laboratory and pilot scale testing will be required to verify the soil washing process. Coordination and approval of regulatory agencies will also be required. As a result, delays in project completion may be anticipated.

Implementation of Alternative 2-3E will require the following detailed studies prior to final design.

a. Development of a safe method for excavating and transporting contaminated soils;

b. Confirmation of wetland excavation methods;

c. Finalization of locations for disposal;

d. Location of suitable backfill material;

e. Development of a soil washing process;

f. Development of a detailed sampling and analysis plan; and

g. Identification of appropriate action levels for implementing future remedial actions.

The time required for implementation of this alternative, other than wetland restoration, is 36 months. Wetland restoration will be completed within five years.

The implementability rating of this alternative is moderate.

Safety. Significant threats to safety are short-term exposure of on-site workers to the contaminated materials, exposure to the safety problems associated with handling the chemical reagents used in the soil washing process, and heavy truck traffic on NWS Concord and the public rights of way during transport of the treated soils and residual sludges to the disposal areas. On-site workers can be protected from the contamination by implementation of appropriate personnel protection programs. Safety problems associated with transport of materials will be minimized by development of a detailed transportation plan during the concept development phase. There are no long term threats to workers or nearby facilities or communities associated with this alternative.

The safety rating of this alternative is moderate.

Level of Remediation Achievable. The level of remediation achievable by this alternative is high. Contaminated material would be removed from EASS 2, rendered non-hazardous by the soil washing process, and disposed of in an existing Class III disposal facility. A concentrated waste stream of contaminants would be produced that would require special treatment and handling, including disposal in an existing Class I landfill. The wetland would be fully restored.

Implementation of the selected criteria is estimated to result in the positive control of the following amounts of contamination.

Arsenic	91 percent	Zinc	88 percent
Cadmium	84 percent	Copper	86 percent
Lead	92 percent	Selenium	75 percent
Nickel	94 percent		

Overall Technical Feasibility Rating. Based on the evaluations presented above, the overall technical feasibility rating of Alternative 2-3E is moderate.

7.1.2.6 Alternative 2-3F

Performance. Alternative 2-3F will be effective in meeting the environmental protection goals since excavation is a proven technology. Excavation can easily be performed to depths below the anticipated level of contamination. Excavated materials can be classified with relative ease and the required clean up levels can be documented. The excavated materials will be treated in a soil washing process and contaminants will be removed from the soil and concentrated in residual sludges. The decontaminated materials will be transported to an engineered Class III monofill constructed on NWS Concord. The contaminants will be concentrated in the reagents used for soil washing. Residual sludges will be disposed of in an existing Class I disposal facility. Wetland restoration would be implemented in accordance with a detailed restoration plan.

Alternative 2-3F provides for removal of contaminated soil material from RASS 2 and is an effective remedy for long term remediation of the contaminated areas. This alternative does not remove some of the contamination that has migrated from the area of the initial discharge of contaminants into surrounding areas. This alternative can successfully address the first element of the environmental protection goals, i.e., "minimize or eliminate the continued release and potential release of hazardous substances." However, the contamination is concentrated into residual sludges requiring disposal in an off-site Class I facility. The volume of these sludges is expected to be approximately twenty percent of the volume of the soil.

The performance rating of Alternative 2-3F is high.

Reliability. The primary technology used in Alternative 2-3F, soil washing, has not been proven on the field scale. The reliability of this alternative would be improved by conduct of extensive laboratory and pilot scale testing.

The effectiveness of the soil washing process can be demonstrated through testing after treatment. If contamination remains, the materials can be directed to Class I or Class II disposal sites rather than a Class III site. In addition, there may be some concern about the ability to restore wetlands on a large scale. After the initial restoration program (5 years) there are no anticipated long term operation and maintenance activities that would be prone to fail. The potential for failure is essentially removed because the contamination is removed from the soil mass, concentrated in residual sludges, and removed from the site. There is some potential that the contamination left in place will cause environmental problems; however, this possibility is addressed through implementation of the long term monitoring program.

Long term operation and maintenance requirements for Alternative 2-3F include the following.

a. Site maintenance for the first five years;

b. Environmental monitoring in accordance with Alternative [illegible] for first five years;

c. Maintenance and monitoring of the monofill; and

d. Annual reports for five years of area on remediation and at least thirty years on on-site disposal facility.

The reliability rating of this alternative is moderate.

<u>Implementability</u>. Labor and materials for most elements of this alternative are readily available. The major exception to this is the availability of a large scale soil washing facility. Since this technology has not been implemented on a large scale, the soil washing facility would have to be custom designed and constructed.

Potential disposal areas have been identified on NWS Concord.

Remaining problem areas include development of a transportation plan that will address public concerns over the transport of contaminated and decontaminated materials on NWS Concord, development of a plan for the transport of residue sludges to an existing Class I disposal facility, and development of a soil washing process. Since the contaminated materials are rendered non-hazardous by the soil washing process, development of an acceptable transportation plan is not believed to have a significant impact on the implementability of the alternative and can be resolved in the concept design phase. Development of a soil washing process will be accomplished during the concept development phase. Since there are no large scale applications of this process, development of an acceptable process may present a significant impediment to timely implementation of this alternative. It is anticipated that extensive laboratory and pilot scale testing will be required to satisfy the soil washing process. Coordination and approval of regulatory agencies will also be required. As a result, delays in project completion may be anticipated.

Implementation of Alternative [illegible] will require the following detailed studies prior to final design:

a. Development of a safe method for excavating and transporting contaminated soils,

b. Confirmation of wetland restoration methods,

c. Finalization of locations for disposal,

d. Location of suitable backfill materials,

e. Development of a soil washing process,

f. Selection of a location for an on-site landfill,

g. Development of a detailed sampling and analysis plan, and

h. Identification of appropriate action levels for implementing future remedial actions.

The time required for implementation of this alternative, other than wetland restoration, is 36 months. Wetland restoration will be completed within five years.

The implementability rating of this alternative is moderate.

Safety. Significant threats to safety are posed by exposure of on-site workers to the contaminated materials, exposure to the safety problems associated with handling the chemical reagents used in the soil washing process, and heavy truck traffic [illegible] transport of the contaminated materials to the disposal areas. On-site workers can be protected from the contamination by implementation of appropriate personnel protection programs. Safety problems associated with transport of contaminated materials will be minimized by development of a detailed transportation plan during the concept development phase. There are no long-term threats to workers or nearby facilities or communities associated with this alternative.

The safety rating of this alternative is moderate.

Level of Remediation Achievable. The level of remediation achievable by this alternative is high. Contaminated material would be removed from RASS 2, rendered non-hazardous by the soil washing process, and disposed of in a Class III on-site disposal facility. A concentrated waste stream of contaminants would be produced that would require special treatment, handling, and disposal in an off-site Class I disposal facility. The wetland would be fully restored.

Implementation of the selected criteria is estimated to result in the positive control of the following amounts of contamination.

Arsenic	91 percent	Zinc	88 percent
Cadmium	84 percent	Copper	86 percent
Lead	92 percent	Selenium	75 percent
Nickel	94 percent		

Overall Technical Effectiveness Rating. Based on the evaluations presented above, the overall technical effectiveness rating of Alternative 2-3F is moderate.

7.1.2.7 Summary of Technical Feasibility Analysis for RASS 2 Alternatives

A detailed summary of the technical feasibility analysis for the alternative remedial actions considered for RASS 2 is presented in Table 7.4. An overall summary is presented in Table 7.5.

7.1.3 Remedial Action Subsite 3

7.1.3.1 Alternative 3-1. No Action

Performance. The no action alternative would provide notice of the contaminated areas in RASS 3 and would reduce somewhat the threat of human contact with the surface soils containing high levels of heavy metals and arsenic. It may not be very effective since nature watchers and children may ignore the warning signs. The warning sign will have to be occasionally maintained and replaced since these may be knocked down, lost, stolen, or damaged. The warning signs provide no protection to the on-site flora and fauna. The no action alternative would leave soils containing high levels of heavy metals in the environment. The no action alternative performance rating is low.

Reliability. The maintenance of the warning sign requires no special operation and maintenance activities. Failure of Alternative 3-1 would result in an increased probability of persons coming into contact with the contaminant materials. Failure of the property record annotation system could result in the unknowing development of the contaminated areas with the resultant spread of contamination. Long term operation and maintenance tasks for Alternative 3-1 include the following.

a. Annual notification plan update;
b. Annual site inspections;
c. Maintenance of signs; and
d. Annual site status report.

The reliability rating is moderate.

Implementability. Since no major construction is anticipated, no special implementation problems are anticipated in implementation of Alternative 3-1. However, regulatory concerns and the degree of public acceptance may preclude implementation of the no action alternative. Implementation of Alternative

Table 7.4

Summary of Technical Feasibility Evaluation for RASS 2 Alternatives

Remedial Alternatives	Criterion			
	Performance		Reliability	
Remedial Alternative	Effectiveness	Useful Life	Operation and Maintenance Requirements	Possible Failure Modes
2-1: No Action	Moderate restriction of access	20-30 years	Annual inspection and sign replacement.	Vandalism, trespass
	Overall performance rating low.		Overall reliability rating high.	
2-2: Environmental Monitoring	Continued evaluation of environment.	30 years	Annual inspection and biannual environmental studies.	Poor selection of "Trigger" contaminant levels.
	Overall performance rating low.		Overall reliability rating high.	
2-3A: Excavation/Disposal At Existing Landfills/ Restoration	Highly effective; removes contaminated materials; restores wetlands.	Not applicable- waste removed	Continuous operation and maintenance during construction; post construction maintenance of wetland first five years; annual inspection and biannual environment studies 30 years.	Failure of wetland restoration; failure of disposal site.
	Overall performance rating high.		Overall reliability rating high.	
2-3C: Excavation/ Immobilization/ Disposal At Existing Landfills/Restoration	Same as 1-3A except contaminants chemically immobilized prior to landfilling.	Same as 1-3A	Same as 1-3A	Same as 1-3A plus concerns about long term stability of chemical immobilization process.
	Overall performance rating high.		Overall reliability rating moderate.	
2-3D: Excavation/ Immobilization/ Disposal at Monofill on NWS Concord/ Restoration	Same as 1-3A except contaminants chemically immobilized prior to landfilling.	Same as 1-3A	Same as 1-3A	Same as 1-3C
	Overall performance rating high.		Overall reliability rating moderate.	
2-3E: Excavation/Soil Washing/Disposal At Existing Landfill/ Restoration	Same as 1-3A except contaminants removed and concentrated in waste side stream.	Same as 1-3A	Same as 1-3A	Same as 1-3A plus possibility that soil washing process will not be effective.
	Overall performance rating high.		Overall reliability rating moderate.	
2-3F: Excavation/Soil Washing/Disposal At Monofill on NWS Concord/ Restoration	Same as 1-3E except decontaminated soils disposed of on-site.	Same as 1-3A	Same as 1-3A	Same as 1-3E
	Overall performance rating high.		Overall reliability rating moderate.	

Table 7.4 (Continued)

S... of Technical Feasibility Evaluation for RASS 2 Alternatives

Remedial Alternatives	Criterion: Implementability — Constructability: Site Conditions	Conditions External to Site	Time: To Implement	Time: To See Desired Results
2-1: No Action	Readily constructable.	Public and regulatory acceptance doubtful.	6 months	6 months
		Overall implementability rating high.		
2-2: Environmental Monitoring	Readily constructable.	Public and regulatory acceptance doubtful.	12 months	12 months
		Overall implementability rating high.		
2-3A: Excavation/Disposal At Existing Landfills/ Restoration	Readily constructable, soft soils may require scheduling during dry season.	Good, public concern about transport of large volumes of contaminated soils through communities.	18 months	60 months (wetland restoration)
		Overall implementability rating moderate.		
2-3C: Excavation/Immobilization/ Disposal At Existing Landfills/Restoration	Same as 1-3A.	Excellent, same as 1-3A except contaminant immobilization will decrease opposition to off-site transport.	30 months	60 months (wetland restoration)
		Overall implementability rating moderate.		
2-3D: Excavation/Immobilization/ Disposal At Monofill at NWS Concord/Restoration	Same as 1-3A plus concerns over disposal site selection.	Same as 1-3A except elimination of off-site transport	30 months	60 months (wetland restoration)
		Overall implementability rating moderate.		
2-3E: Excavation/Soil Washing/ Disposal At Existing Landfill/Restoration	Soil washing never implemented on the scale proposed.	Same as 1-3A except soils decontaminated. Off-site disposal of concentrated contaminants may create public opposition.	36 months	60 months (wetland revegetation)
		Overall implementability rating moderate.		
2-3F: Excavation/Soil Washing/ Disposal At Monofill on NWS Concord/Restoration	Same as 1-3E plus concerns over disposal site selection.	Same as 1-3E	36 months	60 months (wetland revegetation)
		Overall implementability rating moderate.		

Table 7.4 (Concluded)

Summary of Technical Feasibility Evaluation for RASS 2 Alternatives

Remedial Alternatives	Criterion		
	Safety Considerations		Level of Remediation Achievable
Remedial Alternative	Worker Health and Safety	Neighboring Facilities & Communities	
2-1: No Action	Short-term: Potential exposure to contaminants during erection of signs. Long-term: Potential exposure to contaminants during annual inspections.	Short-term: No safety problems Long-term: Potential exposure to trespassers.	Low
	Overall safety rating moderate.		
2-2: Environmental Monitoring	Short-term: Potential exposure to contaminants during initial site studies. Long-term: Potential exposure to contaminants during site investigations.	Short-term: Same as 1-1 Long-term: Same as 1-1	Low
	Overall safety rating moderate.		
2-3A: Excavation/Disposal At Existing Landfills/ Restoration	Short-term: Potential exposure to contamination during excavation and transport operations. Long-term: None.	Short-term: Heavy truck traffic Long-term: None	High
	Overall safety rating high.		
2-3C: Excavation/ Immobilization/Disposal At Existing Landfills/ Restoration	Same as 2-3A.	Same as 2-3A	High
	Overall safety rating high.		
2-3D: Excavation/ Immobilization/Disposal At Monofill on NWS Concord/Restoration	Same as 2-3A.	Same as 2-3A	High
	Overall safety rating high.		
2-3E: Excavation/Soil Washing/Disposal At Existing Landfill/ Restoration	Short-term: Potential exposure to contaminated materials and hazardous chemicals used in soil washing process. Long-term: None.	Short-term: Heavy truck traffic and concentrated contaminants from soil washing process. Long-term: None	High
	Overall safety rating moderate.		
2-3F: Excavation/Soil Washing/Disposal At Monofill on NWS Concord/Restoration	Same as 2-3E.	Same as 2-3E	High
	Overall safety rating moderate.		

Table 7.5

Overall Summary of Technical Feasibility Evaluation for RASS 2 Alternatives

Alternative	Performance	Reliability	Implementability	Safety	Level of Remediation	Overall Technical Feasibility
2-1: No Action	Low	Moderate	High	Moderate	Low	Low
2-2: Environmental Monitoring	Low	Moderate	High	Moderate	Low	Low
2-3A: Excavation/Disposal At Existing Landfills/Restoration	High	High	Moderate	High	High	High
2-3C: Excavation/Immobilization/ Disposal At Existing Landfills/ Restoration	High	Moderate	Moderate	High	High	High
2-3D: Excavation/Immobilization/ Disposal At Monofill on NWS Concord/Restoration	High	Moderate	Moderate	High	High	High
2-3E: Excavation/Soil Washing/ Disposal At Existing Landfill/ Restoration	High	Moderate	Moderate	Moderate	High	Moderate
2-3F: Excavation/Soil Washing/ Disposal At Monofill on NWS Concord/Restoration	High	Moderate	Moderate	Moderate	High	Moderate

3-1 would require no additional detailed studies prior to final design. Implementation would require six months with beneficial results obtained shortly thereafter. The overall implementability rating is high.

Safety. There are no additional safety risks to on- or off-site resulting from the implementation of Alternative 3-1. However, persons entering the posted areas should wear protective clothing and respiratory protection to eliminate the risk of exposure to the contaminants. The overall safety rating is moderate.

Level of Remediation Achievable. No remediation is achieved by this alternative. The primary receptors, on-site wildlife, and vegetation are not protected by Alternative 3-1. The Level of Remediation Level is low.

Overall Technical Feasibility Rating. Based on the evaluations presented above, the overall technical feasibility rating of Alternative 3-1 is low.

7.1.3.2 Alternative 3-2. Environmental Monitoring

Performance. Alternative 3-2 does not meet the selected environmental protection goals and site specific criteria and offers no additional positive protection beyond the no action alternative. However, Alternative 3-2 will allow the continued characterization of the environment in the contaminated and adjacent areas. In addition, implementation of this alternative would document change in contaminant migration patterns. The performance rating is low.

Reliability. Alternative 3-2 is designed to allow the further identification of contaminant transport mechanisms and the quantification of environmental impacts. In addition, this alternative includes provisions for triggering future positive remedial action, if deemed necessary. Failure of this alternative would eliminate the ability to track changes in contaminant migration patterns. Since this alternative provides no initial positive environmental protection, its success or failure would result in the same impacts as the no action alternative. Data collection for the environmental

monitoring program would be very reliable; however, data interpretation and analysis would be less reliable and subject to uncertainty.

Long term operation and maintenance tasks for Alternative 3-2 include the following.

a. Annual notification plan update;

b. Annual site inspections;

c. Maintenance of signs;

d. Environmental monitoring;

e. Annual site status report; and

f. Periodic reports describing the results of environmental monitoring.

The overall reliability rating is moderate.

Implementability. Since no major construction is anticipated, no special implementation problems are anticipated in implementation of Alternative 3-2. There will be problems associated with the interpretation of environmental data and the determination of action levels that would trigger the implementation of positive remedial action measures. These action levels must be quantified in the detailed implementation plan. Regulatory concerns and the degree of public acceptance may preclude implementation of the no action alternative. Implementation would require twelve months with beneficial results obtained shortly thereafter.

Implementation of Alternative 3-2 will require the following detailed studies prior to final design.

a. Development of a detailed sampling and analysis plan; and

b. Identification of appropriate action levels for implementing future remedial actions.

The overall implementability rating is high.

Safety. Minimal additional safety risks are associated with the implementation of Alternative 3-2. These risks are associated with the additional site monitoring which necessitates that personnel go into and adjacent to the contaminated areas. Persons entering the posted areas should wear protective clothing and respiratory protection to eliminate the risk of exposure to the

contaminants. The additional risk is considered to be minimal because of the limited duration of site inspections. The safety rating is moderate.

Level of Remediation Achievable. No remediation is achieved by this alternative. The Level of Remediation is low.

Overall Technical Feasibility Rating. Based on the evaluations presented above, the overall technical feasibility rating of Alternative 3-2 is low.

7.1.3.3 Alternative 3-3A

Performance. Alternative 3-3A will be effective in meeting the environmental protection goals since excavation is a proven technology. Excavation can easily be performed to depths below the anticipated level of contamination. Excavated materials can be classified with relative ease and the required clean up levels can be documented. The excavated materials will be transported by truck or rail to appropriate existing landfills. A fresh water wetland would be created which would serve to reduce the potential for migration of contaminants into the environmentally sensitive wetlands located north of the Southern Pacific railroad right-of-way.

Alternative 3-3A provides for removal of substantial quantities of contaminated soil material from RASS 3 and is the most effective remedy for long term remediation of the contaminated areas. This alternative does not remove some of the contamination that has migrated from the area of initial discharge. This alternative can successfully address the first element of the environmental protection goals, i.e., "minimize or eliminate the continued release and potential release of hazardous substances."

The performance rating of Alternative 3-3A is high.

Reliability. All of the technologies in Alternative 3-3A have been proven in similar site conditions. After the initial revegetation program (2 years) there is no anticipated long term operation and maintenance activities that would be prone to fail. The potential for failure is essentially removed because the contamination is removed from the site. There is some potential

that the contamination left in place will cause environmental problems; however, this possibility is addressed through implementation of the long term monitoring program.

Long term operation and maintenance requirements for Alternative 3-3A include the following.

a. Site maintenance for the first five years;

b. Environmental monitoring in accordance with Alternative 3-2; and

c. Annual reports.

The reliability rating of this alternative is high

Implementability. Labor and materials are readily available for all elements of this alternative. Disposal facilities have been identified; however, the exact disposal location has not been selected. The time required for implementation of this alternative is eighteen months. Wetland areas created by the excavation should revegetate within five years.

The development of a detailed transportation plan will address public concerns over the transport of contaminated materials from NWS Concord to the selected disposal facility. This is not believed to have a significant impact on the implementability of the alternative and can be resolved in the concept design phase. However, some time delays in implementation are anticipated. Transport by rail may be less controversial than truck transport and could be considered as an alternative. Regulatory input would be required in the development of the final transportation and disposal plan. Some project delays may occur.

Implementation of Alternative 3-3A will require the following detailed studies prior to final design.

a. Development of a safe method for excavating and transporting contaminated soils;

b. Confirmation of wetland excavation methods;

c. Finalization of locations for disposal;

d. Location of suitable backfill material;

e. Development of a detailed sampling and analysis plan; and

f. Identification of appropriate action levels for implementing future remedial actions.

The implementability rating of this alternative is moderate.

Safety. The only significant threats to safety are short-term exposure of on-site workers to the contaminated materials and heavy truck traffic through public right-of-way during transport of the contaminated materials to the disposal facilities. On-site workers can be protected from the contamination by implementation of appropriate personnel protection programs. Safety problems associated with the off-site transport of contaminated materials will be minimized by development of a detailed transportation plan during the concept development phase. Safety problems associated with off-site transport would be further minimized if rail transport is selected. There are no long term threats to workers or nearby facilities or communities associated with this alternative.

The safety rating of this alternative is high.

Level of Remediation Achievable. The level of remediation achievable by this alternative is high. Contaminated material would be removed from RASS 3 and disposed of in an existing Class I landfill. In addition, the wetland would be fully restored.

Implementation of the selected criteria is estimated to result in the positive control of the following amounts of contamination.

Arsenic	>94 percent	Zinc	>99 percent
Cadmium	>99 percent	Copper	>99 percent
Lead	>99 percent	Selenium	>99 percent
Nickel	96 percent		

Overall Technical Feasibility Rating. Based on the evaluations presented above, the overall technical feasibility rating of Alternative 3-3A is high.

7.1.3.3 Alternative 3-3C

Performance. Alternative 3-3C will be effective in meeting the environmental protection goals since excavation is a proven technology. Excavation can easily be performed to depths below the anticipated level of contamination. Excavated materials can be classified with relative ease and the required clean up levels can be documented. The excavated materials will be stabilized and the contaminants would be immobilized in the soil mass using solidification/stabilization technology. The stabilized materials will be transported to an existing Class III disposal facility. A freshwater wetland would be created in accordance with a detailed plan.

Alternative 3-3C provides for removal of contaminated soil material from RASS 3 and is an effective remedy for long term remediation of the contaminated areas. This alternative does not remove some of the contamination that has migrated from the area of the initial discharge of contaminants into surrounding areas. This alternative can successfully address the first element of the environmental protection goals, i.e., "minimize or eliminate the continued release and potential release of hazardous substances."

The performance rating of Alternative 3-3C is high.

Reliability. All of the technologies in Alternative 3-3C have been proven in similar site conditions. After the initial revegetation program (2 years) there is no anticipated long term operation and maintenance activities that would be prone to fail. The potential for failure is essentially removed because the contamination is immobilized in the soil mass and removed from the site. There is some potential that the contamination left in place will cause environmental problems; however, this possibility is addressed through implementation of the long term monitoring program.

The long term stability of the immobilized contaminants may be of some concern. This is especially true in the case where the material may be co-disposed in a municipal type (Class III) landfill. The acidic environment of such landfills may adversely affect the solidified/stabilized materials and increase release of the heavy metals. Additional testing may be required

during the development of the stabilization process to document the long term durability of the treated soils.

Long term operation and maintenance requirements for Alternative 3-3C include the following.

a. Site maintenance for the first five years;

b. Environmental monitoring in accordance with Alternative 3-[illegible]; and

c. Periodic reports for five years.

The reliability rating of this alternative is moderate.

Implementability. Labor and materials are readily available for all elements of this alternative. Several potential disposal areas have been identified within an acceptable distance from the site. The time required for implementation of this alternative, other than wetland creation, is 30 months. Wetland revegetation should occur within five years.

The only remaining problem areas are the development of a transportation plan that will address public concerns over the transport of contaminated materials through the public right-of-way and the development of an appropriate stabilization process. Since the contaminated materials are rendered non-hazardous by the stabilization process, development of an acceptable transportation plan is not believed to have a significant impact on the implementability of the alternative and can be resolved in the concept design phase. Development of a stabilization process will be accomplished during the concept development phase. A variety of commercially available processes may be applicable to the contaminants found on RASS III. Development of an acceptable process is not expected to present a significant impediment to implementation of this alternative; however, the use of the TTLC/STLC evaluation procedure tends to complicate the development of an acceptable solidification/stabilization process. Process development will be coordinated with appropriate regulatory agencies, which may cause delays in project approval.

Implementation of Alternative 3-3C will require the following detailed studies prior to final design.

a. Development of a safe method for excavating and transporting contaminated soils;

b. Confirmation of wetland excavation methods;

c. Finalization of locations for disposal;

d. Location of suitable backfill material;

e. Development of contaminant immobilization process;

f. Development of a detailed sampling and analysis plan; and

g. Identification of appropriate action levels for implementing future remedial actions.

The implementability rating of this alternative is moderate.

Safety. The only significant threats to safety are short-term exposure of on-site workers to the contaminated materials and heavy truck traffic on NWS Concord and in nearby communities during transport of the solidified/stabilized materials to the disposal facility. On-site workers can be protected from the contamination by implementation of appropriate personnel protection programs. Safety problems associated with transport of the solidified/stabilized contaminated materials will be minimized by development of a detailed transportation plan during the concept design phase. There are no long term threats to workers or nearby facilities or communities associated with this alternative.

The safety rating of this alternative is high.

Level of Remediation Achievable. The level of remediation achievable by this alternative is high. Contaminated material would be removed from RASS 3, rendered non-hazardous by the stabilization process, and disposed of in an existing licensed disposal facility. In addition, the wetland would be fully restored.

Implementation of the selected criteria is estimated to result in the positive control of the following amounts of cortamination.

Arsenic	94 percent	Zinc	>99 percent
Cadmium	>99 percent	Copper	>99 percent
Lead	>99 percent	Selenium	>99 percent
Nickel	96 percent		

Overall Technical Feasibility Rating. Based on the evaluations presented above, the overall technical feasibility rating of Alternative 3-3C is high.

7.1.3.4 Alternative 3-3D

Performance. Alternative 3-3D will be effective in meeting the environmental protection goals since excavation is a proven technology. Excavation can easily be performed to depths below the anticipated level of contamination. Excavated materials can be classified with relative ease and the required clean up levels can be documented. The excavated materials will be stabilized and the contaminants would be immobilized in the soil mass by the solidification/stabilization process. The stabilized materials will be transported to a monofill constructed on NWS Concord. A freshwater wetland would be created in accordance with a detailed plan.

Alternative 3-3D provides for removal of contaminated soil material from RASS 3 and is an effective remedy for long term remediation of the contaminated areas. This alternative does not remove some of the contamination that has migrated from the area of the initial discharge of contaminants into surrounding areas. This alternative can successfully address the first element of the environmental protection goals, i.e., "minimize or eliminate the continued release and potential release of hazardous substances."

The performance rating of Alternative 3-3D is high.

Reliability. All of the technologies in Alternative 3-3D have been proven in similar site conditions. After the initial revegetation program (2 years) there is no anticipated long term operation and maintenance activities that would be prone to fail. The potential for failure is minimized because the contamination is immobilized in the soil mass and removed from the site. There is some potential that the contamination left in place will cause

environmental problems; however, this possibility is addressed through implementation of the long term monitoring program.

The long term stability of the immobilized contaminants is a primary concern. The possibility of failure of this alternative is minimized by the disposal of the solidified/stabilized materials in a landfill constructed to Class I Standards. None of the monofill sites evaluated on NWS Concord (Lutton 1987) meet Class I facility siting requirements; however, the engineering features of a Class I facility combined with the limited mobility of the contaminants of concern should provide for secure disposal of the solidified/stabilized soils. Additional testing may be required during the development of the stabilization process to document the long term durability of the treated soils.

Long term operation and maintenance requirements for Alternative 3-3D include the following.

a. Site maintenance for the first five years;

b. Environmental monitoring in accordance with Alternative 3-2 for first five years;

c. Maintenance and monitoring of the monofill; and

d. Annual reports for five years on area of remediation and at least thirty years on the monofill facility.

The reliability rating of this alternative is moderate.

Implementability. Labor and materials are readily available for all elements of this alternative. Several potential disposal areas have been identified on NWS Concord. Final site selection would be made in the concept design phase. Final site selection on facility design will be coordinated with appropriate regulatory agencies. Extensive coordination requirements may delay completion of the alternative.

Remaining problem areas include development of a transportation plan that will address public concerns over the transport of contaminated and solidified/stabilized materials on NWS Concord and through neighboring communities between the area of excavation and final disposal. An additional concern is

the development of an appropriate stabilization process. Since the contaminated materials are rendered non-hazardous by the stabilization process, development of an acceptable transportation plan is not believed to have a significant impact on the implementability of the alternative and can be resolved in the concept design phase. Development of a stabilization process will be accomplished during the concept development phase. A variety of commercially available processes may be applicable to the contaminants found on RASS 3.

Development of an acceptable process is not expected to present a significant impediment to implementation of this alternative; however, the use of the TTLC/STLC evaluation procedure tends to complicate the development of an acceptable solidification/stabilization process. Process development will be coordinated with appropriate regulatory agencies, which may cause delays in project approval.

Implementation of Alternative 3-3D will require the following detailed studies prior to final design.

a. Selection of a method for excavating and transporting contaminated soils;

b. Confirmation of wetland excavation methods;

c. Selection of a location for the monofill;

d. Location of suitable backfill material;

e. Development of a contaminant immobilization process;

f. Development of a detailed sampling and analysis plan; and

g. Identification of appropriate action levels for implementing future remedial actions.

The time required for implementation of this alternative, other than wetland restoration, is 30 months. Wetland revegetation should be completed within five years.

The implementability rating of this alternative is moderate.

Safety. The only significant threats to safety are short-term exposure of on-site workers to the contaminated materials and heavy truck traffic on NWS

Concord during transport of the solidified/stabilized materials to the monofill. On-site workers can be protected from the contamination by implementation of appropriate personnel protection programs. Safety problems associated with transport of contaminated and solidified/stabilized materials will be minimized by development of a detailed transportation plan during the concept development phase. There are no long term threats to workers or nearby facilities or communities associated with this alternative.

The safety rating of this alternative is high.

Level of Remediation Achievable. The level of remediation achievable by this alternative is high. Contaminated material would be removed from RASS 3, rendered non-hazardous by the stabilization process, and disposed of in an engineered on-site disposal facility. In addition, the wetland would be fully restored.

Implementation of the selected criteria is estimated to result in the positive control of the following amounts of contamination.

Arsenic	94 percent	Zinc	>99 percent
Cadmium	>99 percent	Copper	>99 percent
Lead	>99 percent	Selenium	>99 percent
Nickel	96 percent		

Overall Technical Feasibility Rating. Based on the evaluations presented above, the overall technical feasibility rating of Alternative 3-3D is high.

7.1.3.5 Alternative 3-3E

Performance. Alternative 3-3E will be effective in meeting the environmental protection goals since excavation is a proven technology. Excavation can easily be performed to depths below the anticipated level of contamination. Excavated materials can be classified with relative ease and the required clean up levels can be documented. The excavated materials will be treated in a soil washing process and contaminants will be removed from the soil. The decontaminated materials will be transported to an existing Class III disposal

facility. The contaminants will be concentrated in the reagents used for soil washing. The residual contaminants will be disposed of in existing Class I facilities. A freshwater wetland would be created in accordance with a detailed restoration plan.

Alternative 3-3E provides for removal of contaminated soil material from RASS 3 and is an effective remedy for long term remediation of the contaminated areas. This alternative does not remove some of the contamination that has migrated from the area of the initial discharge. This alternative can successfully address the first element of the environmental protection goals, i.e., "minimize or eliminate the continued release and potential release of hazardous substances." However, the contamination is concentrated in sludges that will require disposal in a Class I facility. The volume of these sludges is expected to be approximately twenty percent of the volume of soil.

The performance rating of Alternative 3-3E is high.

Reliability. The primary technology used in Alternative 3-3E, soil washing, has not been proven on the field scale. Reliability of this alternative would be improved by conduct of extensive laboratory and pilot scale testing. The effectiveness of the soil washing process can be demonstrated through testing after treatment. If contamination remains, the materials can be directed to Class I or Class II disposal sites rather than a Class III site. After the initial revegetation program (2 years) there are no anticipated long term operation and maintenance activities that would be prone to fail. There is some potential that the contamination left in place will cause environmental problems; however, this possibility is addressed through implementation of the long term monitoring program.

Long term operation and maintenance requirements for Alternative 3-3E include the following.

a. Site maintenance for the first five years;

b. Environmental monitoring in accordance with Alternative 3-2 for first five years; and

c. Annual reports for five years.

The reliability rating of this alternative is moderate.

Implementability. Labor and materials for most elements of this alternative are readily available. The major exception to this is the availability of a large scale soil washing facility. Since this technology has not been widely implemented on a large scale, the soil washing facility would probably have to be custom designed and constructed.

Potential disposal areas have been identified within a reasonable distance from the site.

Remaining problem areas include development of a detailed transportation plan that will address public concerns over the transport of contaminated and decontaminated materials on the NWS Concord and through the public right-of-way and development of a soil washing process. Since the contaminated materials would be rendered non-hazardous by the soil washing process, development of an acceptable transportation plan is not believed to have a significant impact on the implementability of the alternative and can be resolved in the concept design phase. Development of a soil washing process will be accomplished during the concept design phase. Since there are no large scale applications of this process, development of an acceptable process may present a significant impediment to timely implementation of this alternative. It is anticipated that extensive laboratory and pilot scale testing will be required to verify the soil washing process. Coordination and approval of regulatory agencies will also be required. As a result, delays in project completion may be anticipated.

Implementation of Alternative 3-3E will require the following detailed studies prior to final design.

a. Selection of a method for excavating and transporting contaminated soils;

b. Confirmation of wetland excavation methods;

c. Finalization of locations for disposal;

d. Location of suitable backfill material;

e. Development of a soil washing process;

f. Development of a detailed sampling and analysis plan; and

g. Identification of appropriate action levels for implementing future remedial actions.

The time required for implementation of this alternative, other than creation of the freshwater wetland, is 30 months. Wetland revegetation should be completed within four years.

The implementability rating of this alternative is moderate.

Safety. Significant threats to safety are short-term exposure of on-site workers to the contaminated materials, exposure to the safety problems associated with handling the chemical reagents used in the soil washing process, and heavy truck traffic on NWS Concord and the public rights-of-way during transport of the treated soils and residual sludges to the disposal areas. On-site workers can be protected from the contamination by implementation of appropriate personnel protection programs. Safety problems associated with transport of materials will be minimized by development of a detailed transportation plan during the concept development phase. There are no long term threats to workers or nearby facilities or communities associated with this alternative.

The safety rating of this alternative is moderate.

Level of Remediation Achievable. The level of remediation achievable by this alternative is high. Contaminated material would be removed from RASS 3, rendered non-hazardous by the soil washing process, and disposed of in an existing Class III disposal facility. A concentrated waste stream of contaminants would be produced that would require special treatment and handling, including disposal in an existing Class I disposal facility. The wetland would be fully restored.

Implementation of the selected criteria is estimated to result in the positive control of the following amounts of contamination.

Arsenic	94 percent	Zinc	>99 percent
Cadmium	>99 percent	Copper	>99 percent
Lead	>99 percent	Selenium	>99 percent
Nickel	96 percent		

Overall Technical Feasibility Rating. Based on the evaluations presented above, the overall technical feasibility rating of Alternative 3-3E is moderate.

7.1.3.6 Alternative 3-3F

Performance. Alternative 3-3F will be effective in meeting the environmental protection goals since excavation is a proven technology. Excavation can easily be performed to depths below the anticipated level of contamination. Excavated materials can be classified with relative ease and the required clean up levels can be documented. The excavated materials will be treated in a soil washing process and contaminants will be removed from the soil and concentrated in residual sludges. The decontaminated materials will be transported to an engineered Class III monofill constructed on NWS Concord. The contaminants will be concentrated in the reagents used for soil washing. Residual sludges will be disposed of in an existing Class I disposal facility. A freshwater wetland would be created in accordance with a detailed plan.

Alternative 3-3F provides for removal of contaminated soil material from RASS 3 and is an effective remedy for long term remediation of the contaminated areas. This alternative does not remove some of the contamination that has migrated from the area of the initial discharge of contaminants into surrounding areas. This alternative can successfully address the first element of the environmental protection goals, i.e., "minimize or eliminate the continued release and potential release of hazardous substances." However, the contamination is concentrated into residual sludges and requiring disposal in an off-site Class I facility. The volume of these sludges is expected to be approximately twenty percent of the volume of the soil.

The performance rating of Alternative 3-3F is high.

Reliability. The primary technology used in Alternative 3-3F, soil washing, has not been proven on the field scale. The reliability of this alternat ve would be improved by conduct of extensive laboratory and pilot scale testing. The effectiveness of the soil washing process can be demonstrated through testing after treatment. If contamination remains, the materials can be directed to Class I or Class II disposal sites rather than a Class III site. After the initial revegetation program (2 years) there are no anticipated long term operation and maintenance activities that would be prone to fail. The potential for failure is essentially removed because the contamination is removed from the soil mass, concentrated in residual sludges, and removed from the site. There is some potential that the contamination left in place will cause environmental problems; however, this possibility is addressed through implementation of the long term monitoring program.

Long term operation and maintenance requirements for Alternative 3-3F include the following.

a. Site maintenance for the first five years;

b. Environmental monitoring in accordance with Alternative 3-2 for first five years;

c. Maintenance and monitoring of the monofill; and

d. Annual reports for five years on area of remediation and at least thirty years on on-site disposal facility.

The reliability rating of this alternative is moderate.

Implementability. Labor and materials for most elements of this alternative are readily available. The major exception to this is the availability of a large scale soil washing facility. Since this technology has not been implemented on a large scale, the soil washing facility would have to be custom designed and constructed.

Potential disposal areas have been identified on NWS Concord.

Remaining problem areas include development of a transportation plan that will address public concerns over the transport of contaminated and decontaminated materials on NWS Concord, development of a plan for transporting residual

sludges to an existing Class I disposal facility, and development of a soil washing process. Since the contaminated materials are rendered non-hazardous by the soil washing process, development of an acceptable transportation plan is not believed to have a significant impact on the implementability of the alternative and can be resolved in the concept design phase. Development of a soil washing process will be accomplished during the concept development phase. Since there are no large scale applications of this process, development of an acceptable process may present a significant impediment to timely implementation of this alternative. It is anticipated that extensive laboratory and pilot scale testing will be required to verify the soil washing process. Coordination and approval of regulatory agencies will also be required. As a result, delays in project completion may be anticipated.

Implementation of Alternative 3-3F will require the following detailed studies prior to final design.

a. Selection of a method for excavating and transporting contaminated soils;

b. Confirmation of wetland excavation methods;

c. Finalization of locations for disposal;

d. Location of suitable backfill material;

e. Development of a soil washing process;

f. Selection of location for on-site landfill;

g. Development of a detailed sampling and analysis plan; and

h. Identification of appropriate action levels for implementing future remedial actions.

The time required for implementation of this alternative, other than wetland revegetation, is 36 months. Wetland restoration will be completed within four years.

The implementability rating of this alternative is moderate.

<u>Safety</u>. Significant threats to safety are short-term exposure of on-site workers to the contaminated materials, exposure to the safety problems associated with handling the chemical reagents used in the soil washing process, and heavy truck traffic on the NWS Concord and the public rights-of-way during

transport of the contaminated materials to the disposal areas. On-site workers can be protected from the contamination by implementation of appr - priate personnel protection programs. Safety problems associated with trans- port of contaminated materials will be minimized by development of a detailed transportation plan during the concept development phase. There are no long term threats to workers or nearby facilities or communities associated with this alternative.

The safety rating of this alternative is moderate.

Level of Remediation Achievable. The level of remediation achievable by this alternative is high. Contaminated material would be removed from RASS 3, rendered non-hazardous by the soil washing process, and disposed of in an Class III on-site disposal facility. A concentrated waste stream of contami- nants would be produced that would require special treatment, handling, and disposal in an off-site Class I disposal facility. The wetland would be fully restored.

Implementation of the selected criteria is estimated to result in the positive control of the following amounts of contamination.

Arsenic	94 percent	Zinc	>99 percent
Cadmium	>99 percent	Copper	>99 percent
Lead	>99 percent	Selenium	>99 percent
Nickel	96 percent		

Overall Technical Feasibility Rating. Based on the evaluations presented above, the overall technical feasibility rating of Alternative 3-3F is moderate.

7.1.3.7 Summary of Technical Feasibility Analysis for RASS 3 Alternatives

A detailed summary of the technical feasibility analysis for alternative remedial actions considered for RASS 3 is presented in Table 7.5. An overall summary is presented in Table 7.6.

Table 7.6

Summary of Technical Feasibility Evaluation for RASS 3 Alternatives

Remedial Alternatives	Criterion			
	Performance		Reliability	
Remedial Alternative	Effectiveness	Useful Life	Operation and Maintenance Requirements	Possible Failure Modes
3-1: No Action	Moderate restriction of access	20-30 years	Annual inspection and sign replacement.	Vandalism, trespass
	Overall performance rating low.		Overall reliability rating moderate.	
3-2: Environmental Monitoring	*Continued evaluation of* environment.	30 years	Annual inspection and biannual environmental studies.	Poor selection of "Trigger" contaminant levels.
	Overall performance rating low.		Overall reliability rating high.	
3-3A: Excavation/Disposal At Existing Landfills	Highly effective; removes contaminated materials; restores wetlands.	Not applicable-waste removed	Continuous operation and maintenance during construction; post construction maintenance of wetland first five years; annual inspection and biannual environment studies 30 years.	Failure of wetland restoration; failure of disposal site.
	Overall performance rating high.		Overall reliability rating moderate.	
3-3C: Excavation/ Immobilization/ Disposal At Existing Landfills	Same as 3-3A except contaminants chemically immobilized prior to landfilling.	Same as 3-3A	Same as 3-3A	Same as 3-3A plus concerns about long term stability of chemical immobilization process.
	Overall performance rating high.		Overall reliability rating moderate.	
3-3D: Excavation/ Immobilization/ Disposal At Monofill on NWS Concord	Same as 3-3B except contaminants chemically immobilized prior to landfilling.	Same as 3-3B	Same as 3-3B	Same as 3-3C
	Overall performance rating high.		Overall reliability rating moderate.	
3-3E: Excavation/Soil Washing/Disposal At Existing Landfill	Same as 3-3A except contaminants removed and concentrated in waste side stream.	Same as 3-3A	Same as 3-3A	Same as 3-3A plus possibility that soil washing process will not be effective.
	Overall performance rating high.		Overall reliability rating moderate.	
3-3F: Excavation/Soil Washing/Disposal At Monofill on NWS Concord	Same as 3-3E except decontaminated soils disposed of on-site.	Same as 3-3B	Same as 3-3B	Same as 3-3E
	Overall performance rating high.		Overall reliability rating moderate.	

Table 7.6 (Continued)

Summary of Technical Feasibility Evaluation for RASS 3 Alternatives

Remedial Alternatives	Criterion: Implementability			
	Constructability		Time	
Remedial Alternatives	Site Conditions	Conditions External to Site	To Implement	To See Desired Results
3-1: No Action	Readily constructable.	Public and regulatory acceptance doubtful.	6 months	6 months
		Overall implementability rating high.		
3-2: Environmental Monitoring	Readily constructable.	Public and regulatory acceptance doubtful.	12 months	12 months
		Overall implementability rating high.		
3-3A: Excavation/Disposal At Existing Landfills	Readily constructable, soft soils may require scheduling during dry season.	Good, public concern about transport of large volumes of contaminated soils through communities.	18 months	60 months (wetland restoration)
		Overall implementability rating moderate.		
3-3C: Excavation/Immobilization/ Disposal At Existing Landfills	Same as 3-3A.	Excellent, same as 3-3A except contaminant immobilization will decrease opposition to off-site transport.	30 months	60 months (wetland restoration)
		Overall implementability rating moderate.		
3-3D: Excavation/Immobilization/ Disposal at Monofill on NWS Concord	Same as 3-3B.	Same as 3-3C except elimination of off-site transport	30 months	60 months (wetland restoration)
		Overall implementability rating moderate.		
3-3E: Excavation/Soil Washing/ Disposal At Existing Landfill	Soil washing never implemented on the scale proposed.	Same as 3-3A except soils decontaminated. Off-site disposal of concentrated contaminants may create public opposition.	30 months	48 months (wetland revegetation)
		Overall implementability rating moderate.		
3-3F: Excavation/Soil Washing/ Disposal At Monofill on NWS Concord	Same as 3-3E.	Same as 3-3E	36 months	48 months (wetland revegetation)
		Overall implementability rating moderate.		

Table 7.6 (Concluded)

Summary of Technical Feasibility Evaluation for RASS 3 Alternatives

Remedial Alternatives	Criterion: Safety Considerations		Criterion: Level of Remediation Achievable
Remedial Alternative	Worker Health and Safety	Neighboring Facilities & Communities	
3-1: No Action	Short-term: Potential exposure to contaminants during erection of signs. Long-term: Potential exposure to contaminants during annual inspections.	Short-term: No safety problems Long-term: Potential exposure to trespassers.	Low
	Overall safety rating moderate.		
3-2: Environmental Monitoring	Short-term: Potential exposure to contaminants during initial site studies. Long-term: Potential exposure to contaminants during site investigations.	Short-term: Same as 3-1 Long-term: Same as 3-1	Low
	Overall safety rating moderate.		
3-3A: Excavation/Disposal At Existing Landfills	Short-term: Potential exposure to contamination during excavation and transport operations. Long-term: None.	Short-term: Heavy truck traffic Long-term: None	High
	Overall safety rating high.		
3-3C: Excavation/ Immobilization/ Disposal At Existing Landfills	Same as 3-3A.	Same as 3-3A	High
	Overall safety rating high.		
3-3D: Excavation/ Immobilization/Disposal at Monofill on NWS Concord	Same as 3-3A.	Same as 3-3A	High
	Overall safety rating high.		
3-3E: Excavation/Soil Washing/Disposal At Existing Landfill	Short-term: Potential exposure to contaminated materials and hazardous chemicals used in soil washing process. Long-term: None.	Short-term: Heavy truck traffic and concentrated contaminants from soil washing process. Long-term: None	High
	Overall safety rating moderate.		
3-3F: Excavation/Soil Washing/Disposal At Monofill on NWS Concord	Same as 3-3E.	Same as 3-3E	High
	Overall safety rating moderate.		

Table 7.?

Overall Summary of Technical Feasibility Evaluation for RASS 3 Alternatives

Alternative	Performance	Reliability	Implementability	Safety	Level of Remediation	Overall Technical Feasibility
3-1: No Action	Low	Moderate	High	Moderate	Low	Low
3-2: Environmental Monitoring	Low	Moderate	High	Moderate	Low	Low
3-3A: Excavation/Off-Site Disposal	High	High	Moderate	High	High	High
3-3C: Excavation/Immobilization/ Disposal At Existing Landfills	High	Moderate	Moderate	High	High	High
3-3D: Excavation/Immobilization/ Disposal At Monofill on NWS Concord	High	Moderate	Moderate	High	High	High
3-3E: Excavation/Soil Washing/ Disposal At Existing Landfill	High	Moderate	Moderate	Moderate	High	Moderate
3-3F: Excavation/Soil Washing/ Disposal At Monofill on NWS Concord	High	Moderate	Moderate	Moderate	High	Moderate

7.1.4 Remedial Action Subsite 4

7.1.4.1 Alternative 4-1. No Action

Performance. The no action alternative would provide notice of the contaminated areas in RASS 4 and would reduce somewhat the threat of human contact with the surface soils containing high levels of heavy metals and arsenic. It may not be very effective since nature watchers and children may ignore the warning signs. The warning sign will have to be occasionally maintained and replaced since these may be knocked down, lost, stolen, or damaged. The warning signs provide no protection to the on-site flora and fauna. The no action alternative would leave soils containing high levels of heavy metals in the environment. The no action alternative performance rating is low.

Reliability. The maintenance of the warning sign requires no special operation and maintenance activities. Failure of Alternative 4-1 would result in an increase probability of persons coming into contact with the contaminated materials. Failure of the property record annotation system could result in the unknowing development of the contaminated areas with the resultant spread of contamination. Long term operation and maintenance tasks for Alternative 4-1 include the following.

a. Annual notification plan update;
b. Annual site inspections;
c. Maintenance of signs; and
d. Annual site status report.

The reliability rating is moderate.

Implementability. Since no major construction is anticipated, no special implementation problems are anticipated in implementation of Alternative 4-1. However, regulatory concerns and the degree of public acceptance may preclude implementation of the no action alternative. Implementation of Alternative 4-1 would require no additional detailed studies prior to final design. Implementation would require six months with beneficial results obtained shortly thereafter. The implementability rating is high.

Safety. There are no additional safety risks to on- or off-site personnel resulting from the implementation of Alternative 4-1. However, persons entering the posted areas should wear protective clothing and respiratory protection to eliminate the risk of exposure to the contaminants. The safety rating is moderate.

Level of Remediation Achievable. No remediation is achieved by this alternative. The primary receptors, on-site wildlife and vegetation, are not protected by Alternative 4-1. The Level of Remediation is low.

Overall Technical Feasibility Rating. Based on the evaluations presented above, the overall technical feasibility rating of Alternative 4-1 is low.

7.1.4.2 Alternative 4-2. Environmental Monitoring

Performance. Alternative 4-2 does not meet the selected environmental protection goals and site specific criteria and offers no additional positive protection beyond the no action alternative. However, Alternative 4-2 will allow the continued characterization of the environment in the contaminated and adjacent areas. In addition, implementation of this alternative would document changes in contaminant migration patterns. The performance rating is low.

Reliability. Alternative 4-2 is designed to allow the further identification of contaminant transport mechanisms and the quantification of environmental impacts. In addition, this alternative includes provisions for triggering future positive remedial action, if deemed necessary. Failure of this alternative would eliminate the ability to track changes in contaminant migration patterns. Since this alternative provides no initial positive environmental protection, its success or failure would result in the same impacts as the no action alternative. Data collection for the environmental monitoring program would be very reliable; however, data interpretation and analysis would be less reliable and subject to uncertainty.

Long term operation and maintenance tasks for Alternative 4-2 include the following.

a. Annual notification plan update;

b. Annual site inspections;

c. Maintenance of signs;

d. Environmental Monitoring;

e. Annual site status report; and

f. Periodic reports describing the results of environmental monitoring.

The reliability rating for this alternative is moderate.

Implementability. Since no major construction is anticipated, no special implementation problems are anticipated in implementation of Alternative 4-2. There will be problems associated with the interpretation of environmental data and the determination of action levels that would trigger the implementation of positive remedial action measures. These action levels must be quantified in the detailed implementation plan. Regulatory concerns and the degree of public acceptance may preclude implementation of the no action alternative. Implementation would require twelve months with beneficial results obtained shortly thereafter. Implementation of Alternative 4-2 will require the following detailed studies prior to final design.

a. Development of a detailed sampling and analysis plan; and

b. Identification of appropriate action levels for implementing future remedial actions.

The implementability rating is high.

Safety. Minimal additional safety risks are associated with the implementation of Alternative 4-2. These risks are associated with the additional site monitoring which necessitates that personnel go into and adjacent to the contaminated areas. Persons entering the posted areas should wear protective clothing and respiratory protection to eliminate the risk of exposure to the contaminants. The additional risk is considered to be minimal because of the limited duration of site inspections. The safety rating is moderate.

Level of Remediation Achievable. No remediation is achieved by this alternative. The Level of Remediation is low.

Overall Technical Feasibility Rating. Based on the evaluations presented above, the overall technical feasibility rating of Alternative 4-2 is low

7.1.4.3 Alternative 4-3A

Performance. Alternative 4-3A will be effective in meeting the environmental protection goals since excavation is a proven technology. Excavation can easily be performed to depths below the anticipated level of contamination. Excavated materials can be classified with relative ease and the required clean up levels can be documented. The excavated materials will be transported by truck or rail to appropriate existing landfills. Revegetation of RASS 4 would be implemented in accordance with a detailed grading and revegetation plan.

Alternative 4-3A provides for removal of substantial quantities of contaminated soil material from RASS 4 and is the most effective remedies for long term remediation of the contaminated areas. This alternative does not remove some of the contamination that has migrated from the area of initial contamination. This alternative can successfully address the first element of the environmental protection goals, i.e., "minimize or eliminate the continued release and potential release of hazardous substances."

The performance rating of Alternative 4-3A is high.

Reliability. All of the technologies in Alternative 4-3A have been proven on similar site conditions. After the initial revegetation program there are no anticipated long term operation and maintenance activities that would be prone to fail. The potential for failure is essentially removed because the contamination is removed from the site. There is some potential that the contamination left in place will cause environmental problems; however, this possibility is addressed through implementation of the long term monitoring program.

Long term operation and maintenance requirements for Alternative 4-3A include the following.

a. Site maintenance for the first five years;

b. Environmental monitoring in accordance with Alternative 4-2; and

c. Annual reports.

The reliability rating of this alternative is high.

Implementability. Labor and materials are readily available for all elements of this alternative. Disposal facilities have been identified; however, the exact disposal location has not been selected. The time required for implementation of this alternative, other than revegetation, is 18 months. Revegetation will be completed within two years.

The development of a detailed transportation plan will address public concerns over the transport of contaminated materials from NWS Concord to the selected disposal facility. This is not believed to have a significant impact on the implementability of the alternative and can be resolved in the concept design phase; however, some time delays are expected. Transport by rail may be less controversial than truck transport and could be considered as an alternative. Regulatory input would be required in the development of the final transportation and disposal plan. Some project delays may occur.

Implementation of Alternative 4-3A will require the following detailed studies prior to final design.

a. Selection of a method for excavating and transporting contaminated soils;

b. Confirmation of wetland excavation methods;

c. Finalization of locations for disposal;

d. Location of suitable backfill material;

e. Development of a detailed sampling and analysis plan; and

f. Identification of appropriate action levels for implementing future remedial actions.

The implementability rating of this alternative is moderate.

Safety. The only significant threats to safety are short-term exposure of on-site workers to the contaminated materials and heavy truck traffic through

public right-of-way during transport of the contaminated materials to the disposal facilities. On-site workers can be protected from the contamina ion by implementation of appropriate personnel protection programs. Safety problems associated with the off-site transport of contaminated materials can be minimized by development of a detailed transportation plan during the concept development phase. Safety problems associated with off-site transport would be further minimized if rail transport is selected. There are no long term threats to workers or nearby facilities or communities associated with this alternative.

The safety rating of this alternative is high.

Level of Remediation Achievable. The level of remediation achievable by this alternative is high. Contaminated material would be removed from RASS 4 and disposed of in an existing Class I landfill.

Implementation of the selected criteria is estimated to result in the positive control of the following amounts of contamination.

Arsenic	61 percent	Nickel	62 percent
Cadmium	59 percent	Zinc	62 percent
Lead	67 percent	Copper	60 percent

Overall Technical Feasibility Rating. Based on the evaluations presented above, the overall technical feasibility rating of Alternative 4-3A is high.

7.1.4.4 Alternative 4-3C

Performance. Alternative 4-3C will be effective in meeting the environmental protection goals since excavation is a proven technology. Excavation can easily be performed to depths below the anticipated level of contamination. Excavated materials can be classified with relative ease and the required clean up levels can be documented. The excavated materials will be stabilized and the contaminants should be immobilized in the soil mass using solidification/stabilization technology. The stabilized materials will be transported to an existing Class III disposal facility. Site revegetation

would be implemented in accordance with a detailed site grading and revegetation plan.

Alternative 4-3C provides for removal of contaminated soil material from RASS 4 and is an effective remedy for long term remediation of the contaminated areas. This alternative does not remove some of the contamination that has migrated from the area of the initial discharge of contaminants into surrounding areas. This alternative can successfully address the first element of the environmental protection goals, i.e., "minimize or eliminate the continued release and potential release of hazardous substances."

The performance rating of Alternative 4-3C is high.

Reliability. All of the technologies in Alternative 4-3C have been proven on similar site conditions. After the initial revegetation program there are no anticipated long term operation and maintenance activities that would be prone to fail. The potential for failure is essentially removed because the contamination is immobilized in the soil mass and removed from the site. There is some potential that the contamination left in place will cause environmental problems; however, this possibility is addressed through implementation of the long term monitoring program.

The long term stability of the immobilized contaminants may be of some concern. This is especially true in the case where the material may be co-disposed in a municipal type (Class III) landfill. The acidic environment of such landfills may adversely affect the solidified/stabilized materials and increase release of the heavy metals. Additional testing may be required during the development of the stabilization process to document the long term durability of the treated soils.

Long term operation and maintenance requirements for Alternative 4-3C include the following.

a. Site maintenance for the first five years;
b. Environmental monitoring in accordance with Alternative 4-2;
c. Periodic reports for five years.

The reliability rating of this alternative is moderate.

Implementability. Labor and materials are readily available for all elements of this alternative. Several potential disposal areas have been identified within an acceptable distance from the site. The time required for implementation of this alternative, other than wetland restoration, is 24 months. Site revegetation will be completed within three years.

The only remaining problem areas are the development of a transportation plan that will address public concerns over the transport of contaminated materials through the public right-of-way and the development of an appropriate stabilization process. Since the contaminated materials are rendered non-hazardous by the stabilization process, development of an acceptable transportation plan is not believed to have a significant impact on the implementability of the alternative and can be resolved in the concept design phase. Development of a stabilization process will be accomplished during the concept development phase. A variety of commercially available processes may be applicable to the contaminants found on RASS 4. Development of an acceptable process is not expected to present a significant impediment to implementation of this alternative; however, the use of the TTLC/STLC evaluation procedure tends to complicate the development of an acceptable solidification/stabilization process. Process development will be coordinated with appropriate regulatory agencies, which may cause delays in project approval.

Implementation of Alternative 4-3C will require the following detailed studies prior to final design.

a. Selection of a method for excavating and transporting contaminated soils;

b. Confirmation of wetland excavation methods;

c. Finalization of locations for disposal;

d. Location of suitable backfill material;

e. Development of a contaminant immobilization process;

f. Development of a detailed sampling and analysis plan; and

g. Identification of appropriate action levels for implementing future remedial actions.

The implementability rating of this alternative is moderate.

Safety. The only significant threats to safety are short-term exposure of on-site workers to the contaminated materials and heavy truck traffic on NWS Concord and in nearby communities during transport of the solidified/stabilized materials to the disposal facility. On-site workers can be protected from the contamination by implementation of appropriate personnel protection programs. Safety problems associated with transport of contaminated and solidified/stabilized materials will be minimized by development of a detailed transportation plan during the concept development phase. There are no long term threats to workers or nearby facilities or communities associated with this alternative.

The safety rating of this alternative is high.

Level of Remediation Achievable. The level of remediation achievable by this alternative is high. Contaminated material would be removed from RASS 4, rendered non-hazardous by the stabilization process, and disposed of in an existing licensed disposal facility.

Implementation of the selected criteria is estimated to result in the positive control of the following amounts of contamination.

Arsenic	61 percent	Nickel	62 percent
Cadmium	59 percent	Zinc	62 percent
Lead	67 percent	Copper	60 percent

Overall Technical Feasibility Rating. Based on the evaluations presented above, the overall technical feasibility rating of Alternative 4-3C is high.

7.1.4.5 Alternative 4-3D

Performance. Alternative 4-3D will be effective in meeting the environmental protection goals since excavation is a proven technology. Excavation can easily be performed to depths below the anticipated level of contamination. Excavated materials can be classified with relative ease and the required

clean up levels can be documented. The excavated materials will be stabilized and the contaminants would be immobilized in the soil mass by the solidification/stabilization process. The stabilized materials will be transported to a monofill constructed on NWS Concord. Site revegetation would be implemented in accordance with a detailed site grading and revegetation plan.

Alternative 4-3D provides for removal of contaminated soil material from RASS 4 and is an effective remedy for long term remediation of the contaminated areas. This alternative does not remove some of the contamination that has migrated from the area of the initial discharge of contaminants into surrounding areas. This alternative can successfully address the first element of the environmental protection goals, i.e., "minimize or eliminate the continued release and potential release of hazardous substances."

The performance rating of Alternative 4-3D is high.

Reliability. All of the technologies in Alternative 4-3D have been proven in similar site conditions. After the initial revegetation program there is no anticipated long term operation and maintenance activities that would be prone to fail. The potential for failure is minimized because the contamination is immobilized in the soil mass and removed from the site. There is some potential that the contamination left in place will cause environmental problems; however, this possibility is addressed through implementation of the long term monitoring program.

The long term stability of the immobilized contaminants is a primary concern. The possibility of failure of this alternative is minimized by the disposal of the solidified/stabilized materials in a landfill constructed to Class I standards. None of the monofill sites evaluated on NWS Concord (Lutton et al 1987) meet Class I facility siting requirements; however, the engineering features of a Class I facility combined with the limited mobility of the contaminants of concern should provide for secure disposal of the solidified/stabilized soils. Additional testing may be required during the development of the stabilization process to document the long term durability of the treated soils.

Long term operation and maintenance requirements for Alternative 4-3D include the following.

a. Site maintenance for the first five years;

b. Environmental monitoring in accordance with Alternative 4-2 for first five years;

c. Maintenance and monitoring of the monofill; and

d. Annual reports for five years on area of remediation and at least thirty years on the monofill facility.

The reliability rating of this alternative is moderate.

Implementability. Labor and materials are readily available for all elements of this alternative. Several potential disposal areas have been identified on NWS Concord. Final site selection would be made in the concept design phase. Final site selection on facility design will be coordinated with appropriate regulatory agencies. Extensive coordination requirements may delay completion of the alternative.

Remaining problem areas are development of a transportation plan that will address public concerns over the transport of contaminated and solidified/stabilized materials on NWS Concord and development of an appropriate stabilization process. Since the contaminated materials are rendered non-hazardous by the stabilization process, development of an acceptable transportation plan is not believed to have a significant impact on the implementability of the alternative and can be resolved in the concept design phase. Development of a stabilization process will be accomplished during the concept development phase. A variety of commercially available processes may be applicable to the contaminants found on RASS 4. Development of an acceptable process is not expected to present a significant impediment to implementation of this alternative; however, the use of the TTLC/STLC evaluation procedure tends to complicate the development of an acceptable solidification/stabilization process. Process development will be coordinated with appropriate regulatory agencies, which may cause delays in project approval.

Implementation of Alternative 4-3D will require the following detailed studies prior to final design.

a. Selection of a method for excavating and transporting contaminated soils;

b. Confirmation of wetland excavation methods;

c. Finalization of locations for disposal;

d. Location of suitable backfill material;

e. Development of a contaminant immobilization process;

f. Select location for on-site landfill;

g. Development of a detailed sampling and analysis plan; and

h. Identification of appropriate action levels for implementing future remedial actions.

The time required for implementation of this alternative is 36 months. Site revegetation will be completed within four years.

The implementability rating of this alternative is moderate.

Safety. The only significant threats to safety are short-term exposure of on-site workers to the contaminated materials and heavy truck traffic on NWS Concord during transport of the solidified/stabilized materials to the monofill. On-site workers can be protected from the contamination by implementation of appropriate personnel protection programs. Safety problems associated with transport of contaminated and solidified/stabilized materials will be minimized by development of a detailed transportation plan during the concept development phase. There are no long term threats to workers or nearby facilities or communities associated with this alternative.

The safety rating of this alternative is high.

Level of Remediation Achievable. The level of remediation achievable by this alternative is high. Contaminated material would be removed from RASS 4, rendered non-hazardous by the stabilization process, and disposed of in an engineered monofill facility.

Implementation of the selected criteria is estimated to result in the positive control of the following amounts of contamination.

Arsenic	61 percent	Nickel	62 percent
Cadmium	59 percent	Zinc	62 percent
Lead	67 percent	Copper	60 percent

Overall Technical Feasibility Rating. Based on the evaluations presented above, the overall technical effectiveness rating of Alternative 4-3D is high.

7.1.4.6 Alternative 4-3E

Performance. Alternative 4-3E will be effective in meeting the environmental protection goals since excavation is a proven technology. Excavation can easily be performed to depths below the anticipated level of contamination. Excavated materials can be classified with relative ease and the required clean up levels can be documented. The excavated materials will be treated in a soil washing process and contaminants will be removed from the soil. The decontaminated materials will be transported to an existing Class III disposal facility. The contaminants will be concentrated in the reagents used for soil washing. Residual contaminants will be disposed of in existing Class I facilities. Site revegetation would be implemented in accordance with a detailed site grading and revegetation plan.

Alternative 4-3E provides for removal of contaminated soil material from RASS 4 and is an effective remedy for long term remediation of the contaminated areas. This alternative does not remove some of the contamination that has migrated from the area of the initial discharge. This alternative can successfully address the first element of the environmental protection goals, i.e., "minimize or eliminate the continued release and potential release of hazardous substances." However, the contamination is concentrated in sludges and requires disposal in a Class I facility. The volume of these sludges is expected to be approximately twenty percent of the volume of soil.

The performance rating of Alternative 4-3E is high.

Reliability. The primary technology used in Alternative 4-3E, soil washing, has not been proven on the field scale. Reliability of this alternative would be improved by conduct of extensive laboratory and pilot scale testing. The

effectiveness of the soil washing process can be demonstrated through testing after treatment. If contamination remains, the materials can be directed to Class I or Class II disposal sites rather than a Class III site. After the initial revegetation program there is no anticipated long term operation and maintenance activities that would be prone to fail. There is some potential that the contamination left in place will cause environmental problems; however, this possibility is addressed through implementation of the long term monitoring program.

Long term operation and maintenance requirements for Alternative 4-3E include the following.

a. Site maintenance for the first five years;

b. Environmental monitoring in accordance with Alternative 4-2 for first five years; and

c. Annual reports for five years.

The reliability rating of this alternative is moderate.

Implementability. Labor and materials for most elements of this alternative are readily available. The major exception to this is the availability of a large scale soil washing facility. Since this technology has not been widely implemented on a large scale, the soil washing facility would probably have to be custom designed and constructed.

Potential disposal areas have been identified within a reasonable distance from the site.

Remaining problem areas include development of a detailed transportation plan that will address public concerns over the transport of contaminated and decontaminated materials on NWS Concord and through the public right-of-way and development of a soil washing process. Since the contaminated materials would be rendered non-hazardous by the soil washing process, development of an acceptable transportation plan is not believed to have a significant impact on the implementability of the alternative and can be resolved in the concept design phase. Development of a soil washing process will be accomplished

during the concept development phase. Since there are no large scale applications of this process, development of an acceptable process may present a significant impediment to timely implementation of this alternative. It is anticipated that extensive laboratory and pilot scale testing will be required to verify the soil washing process. Coordination and approval of regulatory agencies will also be required. As a result, delays in project completion may be anticipated.

Implementation of Alternative 4-3E will require the following detailed studies prior to final design.

a. Selection of a method for excavating and transporting contaminated soils;

b. Confirmation of wetland excavation methods;

c. Finalization of locations for disposal;

d. Location of suitable backfill material;

e. Development of a soil washing process;

f. Development of a detailed sampling and analysis plan; and

g. Identification of appropriate action levels for implementing future remedial actions.

The time required for implementation of this alternative, other than site revegetation is 36 months. Site revegetation will be completed within four years.

The implementability rating of this alternative is moderate.

Safety. Significant threats to safety are short-term exposure of on-site workers to the contaminated materials, exposure to the safety problems associated with handling the chemical reagents used in the soil washing process, and heavy truck traffic on NWS Concord and the public rights-of-way during transport of the treated soils and residual sludges to the disposal areas. On-site workers can be protected from the contamination by implementation of appropriate personnel protection programs. Safety problems associated with transport of materials will be minimized by development of a detailed transportation plan during the concept development phase. There are no long term

threats to workers or nearby facilities or communities associated with this alternative.

The safety rating of this alternative is moderate.

Level of Remediation Achievable. The level of remediation achievable by this alternative is high. Contaminated material would be removed from RASS 4, rendered non-hazardous by the soil washing process, and disposed of in an existing Class III disposal facility. A concentrated waste stream of contaminants would be produced that would require special treatment and handling, including disposal in a Class I disposal facility.

Implementation of the selected criteria is estimated to result in the positive control of the following amounts of contamination.

Arsenic	61 percent	Nickel	62 percent
Cadmium	59 percent	Zinc	62 percent
Lead	67 percent	Copper	60 percent

Overall Technical Feasibility Rating. Based on the evaluations presented above, the overall technical feasibility rating of Alternative 4-3E is moderate.

7.1.4.7 Alternative 4-3F

Performance. Alternative 4-3F will be effective in meeting the environmental protection goals since excavation is a proven technology. Excavation can easily be performed to depths below the anticipated level of contamination. Excavated materials can be classified with relative ease and the required clean up levels can be documented. The excavated materials will be treated in a soil washing process and contaminants will be removed from the soil and concentrated in residual sludges. The decontaminated materials will be transported to an engineered on-site Class III monofill constructed on NWS Concord. The contaminants will be concentrated in the reagents used for soil washing. Residual sludges will be disposed of in an existing Class I disposal

facility. Site revegetation would be implemented in accordance with a detailed site grading and revegetation plan.

Alternative 4-3F provides for removal of contaminated soil material from RASS 4 and is an effective remedy for long term remediation of the contaminated areas. This alternative does not remove some of the contamination that has migrated from the area of the initial discharge of contaminants into surrounding areas. This alternative can successfully address the first element of the environmental protection goals, i.e., "minimize or eliminate the continued release and potential release of hazardous substances." However, the contamination is concentrated into residual sludges requiring disposal in an off-site Class I facility. The volume of these sludges is expected to be approximately twenty percent of the volume of soil.

The performance rating of Alternative 4-3F is high.

Reliability. The primary technology used in Alternative 4-3F, soil washing, has not been proven on the field scale. The reliability of this alternative would be improved by conduct of extensive laboratory and pilot scale testing. The effectiveness of the soil washing process can be demonstrated through testing after treatment. If contamination remains, the materials can be directed to Class I or Class II disposal sites rather than a Class III site. After the initial revegetation program there are no anticipated long term operation and maintenance activities that would be prone to fail. The potential for failure is essentially removed because the contamination is removed from the soil mass, concentrated in residual sludges, and removed from the site. There is some potential that the contamination left in place will cause environmental problems; however, this possibility is addressed through implementation of the long term monitoring program.

Long term operation and maintenance requirements for Alternative 4-3F include the following.

a. Site maintenance for the first five years;

b. Environmental monitoring in accordance with Alternative 4-2 for first five years;

c. Maintenance and monitoring of the monofill; and

d. Annual reports for five years on area of remediation and at least thirty years on on-site disposal facility.

The reliability rating of this alternative is moderate.

Implementability. Labor and materials for most elements of this alternative are readily available. The major exception to this is the availability of a large scale soil washing facility. Since this technology has not been implemented on a large scale, the soil washing facility would have to be custom designed and constructed.

Potential disposal areas have been identified on site.

Remaining problem areas include development of a transportation plan that will address public concerns over the transport of contaminated and decontaminated materials on NWS Concord, development of a plan to transport residual sludges to an existing Class I disposal facility, and development of a soil washing process. Since the contaminated materials are rendered non-hazardous by the soil washing process, development of an acceptable transportation plan is not believed to have a significant impact on the implementability of the alternative and can be resolved in the concept design phase. Development of a soil washing process will be accomplished during the concept design phase. Since there are no large scale applications of this process, development of an acceptable process will require extensive studies and may present a significant impediment to timely implementation of this alternative. It is anticipated that extensive laboratory and pilot scale testing will be required to verify the soil washing process. Coordination and approval of regulatory agencies will also be required. As a result, delays in project completion may be anticipated.

Implementation of Alternative 4-3F will require the following detailed studies prior to final design.

a. Selection of a method for excavating and transporting contaminated soils;

b. Confirmation of wetland excavation methods;

c. Finalization of locations for disposal;

d. Location of suitable backfill material;

e. Development of a soil washing process;

f. Development of a detailed sampling and analysis plan; and

g. Identification of appropriate action levels for implementing future remedial actions.

The time required for implementation of this alternative, other than wetland restoration, is 36 months. Site revegetation will be completed within four years.

The implementability rating of this alternative is moderate.

Safety. Significant threats to safety are short-term exposure of on-site workers to the contaminated materials, exposure to the safety problems associated with handling the chemical reagents used in the soil washing process, and heavy truck traffic on NWS Concord and the public rights-of-way during transport of the contaminated materials to the disposal areas. On-site workers can be protected from the contamination by implementation of appropriate personnel protection programs. Safety problems associated with transport of contaminated materials will be minimized by development of a detailed transportation plan during the concept development phase. There are no long term threats to workers or nearby facilities or communities associated with this alternative.

The safety rating of this alternative is moderate.

Level of Remediation Achievable. The level of remediation achievable by this alternative is high. Contaminated material would be removed from RASS 4, rendered non-hazardous by the soil washing process, and disposed of in a Class III on-site disposal facility. A concentrated waste stream of contaminants would be produced that would require special treatment, handling, and disposal in an off-site Class I disposal facility.

Implementation of the selected criteria is estimated to result in the positive control of the following amounts of contamination.

Arsenic	61 percent	Nickel	62 percent
Cadmium	59 percent	Zinc	62 per ent
Lead	67 percent	Copper	60 perLent

Overall Technical Feasibility Rating. Based on the evaluations presented above, the overall technical feasibility rating of Alternative 4-3F is moderate.

7.1.4.8 Alternative 4-4A

Performance. Alternative 4-4A is designed to prevent migration of the contaminants from RASS 4 along surface and airborne pathways. The effectiveness of the containment cap is considered to be good. The useful life of the cap is unknown, however, with proper maintenance is expected to approach 30 years.

The performance rating of Alternative 4-4A is moderate.

Reliability. Materials for construction of the cap are readily available. The cap would require no operation and only minimal maintenance, including grass mowing and and annual inspection.

Long term operation and maintenance requirements for Alternative 4-4A include the following.

a. Maintenance of the top soil cover;

b. Annual site inspections;

c. Biannual environmental monitoring in accordance with Alternative 4-2; and

d. Annual site status reports and biannual environmental monitoring reports.

The reliability rating for Alternative 4-4A is high.

Implementability. Constructability of the cap considering onsite conditions is good. Implementability of the cap considering offsite conditions is good. The time required for implementation of this alternative, other than wetland

restoration, is 12 months. Site revegetation will be completed within two years.

Implementation of Alternative 4-4A will require the following detailed studies prior to final design.

a. Location of suitable borrow areas for fill and cap materials;

b. Slope stability analysis for the cap design;

c. Development of a detailed sampling and analysis plan; and

d. Identification of appropriate action levels for implementing future remedial actions.

The implementability rating for Alternative 4-4A is moderate.

Safety. The short-term threat to on-site workers is exposure to the contaminated materials during construction of the cap. This can be minimized through implementation of a personnel protection program. There is no long term threat to on-site workers.

The short term safety threat to off-site personnel is related to the transport of capping material to RASS 4. This can be minimized through proper planning. There will be no off-site exposure to the contaminated materials.

The safety rating of Alternative 4-4A is high.

Level of Remediation Achievable. The level of remediation achievable by Alternative 4-4A is moderate. Contaminated materials would remain on-site and be subject to further migration and redistribution should the cap fail.

Overall Technical Feasibility Rating. Based on the evaluations presented above, the overall technical effectiveness rating of Alternative 4-4A is moderate.

7.1.4.9 Alternative 4-4B

Performance. Alternative 4-4B is designed to prevent migration of the contaminants from RASS 4 along surface, ground water, and airborne pathways.

The effectiveness of the containment cap is considered to be good. The useful life of the cap is unknown, however, with proper maintenance is expected › approach 30 years.

The performance rating of Alternative 4-4B is moderate.

Reliability. Materials for construction of the cap are readily available. The cap would require no operation and only minimal maintenance, including grass mowing and annual inspection.

Long term operation and maintenance requirements for Alternative 4-4B include the following.

a. Maintenance of the multilayered cover;

b. Annual site inspections;

c. Biannual environmental monitoring in accordance with Alternative 4-2; and

d. Annual site status reports and biannual environmental monitoring reports.

The reliability rating for Alternative 4-4B is high.

Implementability. Constructability of the cap considering onsite conditions is good. Implementability of the cap considering offsite conditions is good.

Implementation of Alternative 4-4B will require the following detailed studies prior to final design. The time required for implementation of this alternative, other than wetland restoration, is 12 months. Site revegetation will be completed within two years.

a. Location of suitable borrow areas for fill and cap materials;

b. Slope stability analysis for the cap design;

c. Development of a detailed sampling and analysis plan; and

d. Identification of appropriate action levels for implementing future remedial actions.

The implementability rating for Alternative 4-4B is moderate.

Safety. The short-term threat to on-site workers is exposure to the contaminated materials during construction of the cap. This can be minimized through implementation of a personnel protection program. There is no long term threat to on-site workers.

The short term safety threat to off-site personnel is related to the transport of capping material to RASS 4. This can be minimized through proper planning. There will be no off-site exposure to the contaminated materials.

The safety rating of Alternative 4-4B is high.

Level of Remediation Achievable. The level of remediation achievable by Alternative 4-4B is moderate. Contaminated materials would remain on-site and be subject to further migration and redistribution should the cap fail.

Overall Technical Feasibility Rating. Based on the evaluations presented above, the overall technical feasibility rating for Alternative 4-4B is moderate.

7.1.4.10 Summary of Technical Feasibility Analysis for RASS 4 Alternatives

A detailed summary of the technical feasibility analysis for alternative remedial actions considered for RASS 4 is presented in Table 7.8. An overall summary is presented in Table 7.9.

7.2 Environmental Considerations

Each remedial alternative was evaluated on the basis of beneficial and adverse effects, with consideration given to feasible mitigation measures. The evaluation process required assessment of existing perturbation from identified contaminants, the degree to which each alternative would alleviate the perturbation, and additional stresses that might result from the cleanup measures themselves. Hydrological evaluations considered possible below-ground transport of contaminants to the adjacent aquifer, transport of contaminants via surface water to aquatic and wetland ecosystems, and effects on tidal flow patterns.

Table 7.8

Summary of Technical Feasibility Evaluation for RASS 4 Alternatives

Remedial Alternatives	Criterion			
	Performance		Reliability	
Remedial Alternative	Effectiveness	Useful Life	Operation and Maintenance Requirements	Possible Failure Modes
4-1: No Action	Moderate restriction of access	20-30 years	Annual inspection and sign replacement.	Vandalism, trespass
	Overall performance rating low.		Overall reliability rating moderate.	
4-2: Environmental Monitoring	Continued evaluation of environment.	30 years	Annual inspection and biannual environmental studies.	Poor selection of "Trigger" contaminant levels.
	Overall performance rating low.		Overall reliability rating moderate.	
4-3A: Excavation/Disposal At Existing Landfills	Highly effective; removes contaminated materials.	Not applicable-waste removed	Continuous operation and maintenance during construction; post construction maintenance first five years; annual inspection and biannual environment studies 30 years.	Failure of disposal site.
	Overall performance rating high.		Overall reliability rating high.	
4-3C: Excavation/ Immobilization/ Disposal At Existing Landfills	Same as 4-3A except contaminants chemically immobilized prior to landfilling.	Same as 4-3A	Same as 4-3A	Same as 4-3A plus concerns about long term stability of chemical immobilization process.
	Overall performance rating high.		Overall reliability rating moderate.	
4-3D: Excavation/ Immobilization/ Disposal At Monofill on NWS Concord	Same as 4-3A except contaminants chemically immobilized prior to landfilling.	Same as 4-3A	Same as 4-3A	Same as 4-3C
	Overall performance rating high.		Overall reliability rating high.	
4-3E: Excavation/Soil Washing/Disposal At Existing Landfill	Same as 4-3A except contaminants removed and concentrated in waste side stream.	Same as 4-3A	Same as 4-3A	Same as 4-3A plus possibility that soil washing process will not be effective.
	Overall performance rating high.		Overall reliability rating moderate.	
4-3F: Excavation/Soil Washing/Disposal At Monofill on NWS Concord	Same as 4-3E except decontaminated soils disposed of on-site.	Same as 4-3B	Same as 4-3B	Same as 4-3E
	Overall performance rating high.		Overall reliability rating moderate.	
4-4A: Source Isolation/ Soil Cap	Moderately effective. Prevents migration from site via surface water.	20-30 years	Annual inspection and monitoring. Periodic cap repair.	Soil erosion and cap degradation.
	Overall performance rating moderate.		Overall reliability rating high.	
4-4B: Source Isolation/ RCRA Cap	Moderately effective. Prevents migration of contaminants via surface and ground water.	20-30 years	Annual inspection and monitoring. Periodic cap repair.	Soil erosion and cap degradation.
	Overall performance rating moderate.		Overall reliability rating high.	

Table 7.8 (Continued)

Summary of Technical Feasibility Evaluation fpr RASS 4 Alternatives

Remedial Alternatives	Criterion: Implementability			
	Constructability		Time	
Remedial Alternatives	Site Conditions	Conditions External to Site	To Implement	To See Desired Results
4-1: No Action	Readily constructable.	Public and regulatory acceptance doubtful.	6 months	6 months
		Overall implementability rating high.		
4-2: Environmental Monitoring	Readily constructable.	Public and regulatory acceptance doubtful.	12 months	12 months
		Overall implementability rating high.		
4-3A: Excavation/Disposal At Existing Landfills	Readily constructable, soft soils may require scheduling during dry season.	Good, public concern about transport of large volumes of contaminated soils through communities.	18 months	24 months (area revegetation)
		Overall implementability rating moderate.		
4-3C: Excavation/Immobilization/ Disposal At Existing Landfills	Same as 4-3A.	Excellent, same as 4-3A except contaminant immobilization will decrease opposition to off-site transport.	24 months	36 months (area revegetation)
		Overall implementability rating moderate.		
4-3D: Excavation/Immobilization/ Disposal at Monofill on NWS Concord	Same as 4-3A.	Same as 4-3C except elimination of off-site transport	36 months	48 months (area revegetation)
		Overall implementability rating moderate.		
4-3E: Excavation/Soil Washing/ Disposal At Existing Landfill	Soil washing never implemented on the scale proposed.	Same as 4-3A except soils decontaminated. Off-site disposal of concentrated contaminants may create public opposition.	36 months	48 months (area revegetation)
		Overall implementability rating moderate.		
4-3F: Excavation/Soil Washing/ Disposal At Monofill on NWS Concord	Same as 4-3E.	Same as 4-3E	36 months	48 months (area revegetation)
		Overall implementability rating moderate.		
4-4A: *Source Isolation/ Soil Cap*	Readily constructable. Geo-technical evaluation required.	Public and regulatory concerns over containment remedy.	12 months	24 months
		Overall implementability rating moderate.		
4-4B: Source Isolation/ RCRA Cap	Same as 4-4A.	Same as 4-4A.	12 months	24 months
		Overall implementability rating moderate.		

Table 7.8 (Concluded)

Summary of Technical Feasibility Evaluation for RASS 4 Alternatives

Remedial Alternatives	Criterion		
	Safety Considerations		Level of Remediation Achievable
Remedial Alternative	Worker Health and Safety	Neighboring Facilities & Communities	
4-1: No Action	Short-term: Potential exposure to contaminants during erection of signs. Long-term: Potential exposure to contaminants during annual inspections.	Short-term: No safety problems Long-term: Potential exposure to trespassers.	Low
	Overall safety rating moderate.		
4-2: Environmental Monitoring	Short-term: Potential exposure to contaminants during initial site studies. Long-term: Potential exposure to contaminants during site investigations.	Short-term: Same as 4-1 Long-term: Same as 4-1	Low
	Overall safety rating moderate.		
4-3A: Excavation/Disposal At Existing Landfills	Short-term: Potential exposure to contamination during excavation and transport operations. Long-term: None.	Short-term: Heavy truck traffic Long-term: None	High
	Overall safety rating high.		
4-3C: Excavation/ Immobilization/Disposal At Existing Landfills	Same as 4-3A.	Same as 4-3A	High
	Overall safety rating high.		
4-3D: Excavation/ Immobilization/Disposal at Monofill on NWS Concord	Same as 4-3A.	Same as 4-3A	High
	Overall safety rating high.		
4-3E: Excavation/Soil Washing/ Disposal At Existing Landfill	Short-term: Potential exposure to contaminated materials and hazardous chemicals used in soil washing process. Long-term: None.	Short-term: Heavy truck traffic and concentrated contaminants from soil washing process. Long-term: None	High
	Overall safety rating moderate.		
4-3F: Excavation/Soil Washing/ Disposal At Monofill on NWS Concord	Same as 4-3E.	Same as 4-3E	High
	Overall safety rating moderate.		
4-4A: Source Isolation/ Soil Cap	Short-term: Potential exposure to contamination during capping. Long-term: None.	Short-term: Heavy truck traffic unless materials found on-site Long-term: None unless cap fails.	Moderate
	Overall safety rating high.		
4-4B: Source Isolation/ RCRA Cap	Same as 4-4A.	Same as 4-4A.	Moderate
	Overall safety rating high.		

Table 7.9

Summary of Technical Feasibility Evaluation for RASS 4 Alternatives

Alternative	Performance	Reliability	Implementability	Safety	Level of Remediation	Overall Technical Feasibility
4-1: No Action	Low	Moderate	High	Moderate	Low	Low
4-2: Environmental Monitoring	Low	Moderate	High	Moderate	Low	Low
4-3A: Excavation/Disposal At Existing Landfills	High	High	Moderate	High	High	High
4-3C: Excavation/Immobilization/ Disposal At Existing Landfills	High	Moderate	Moderate	High	High	High
4-3D: Excavation/Immobilization/ Disposal at Monofill on NWS Concord	High	Moderate	Moderate	High	High	High
4-3E: Excavation/Soil Washing/ Disposal At Existing Landfill	High	Moderate	Moderate	Moderate	High	Moderate
4-3F: Excavation/Soil Washing/ Disposal At Monofill on NWS Concord	High	Moderate	Moderate	Moderate	High	Moderate
4-4A: Source Isolation/Soil Cap	Moderate	High	Moderate	High	Moderate	Moderate
4-4B: Source Isolation/RCRA Cap	Moderate	High	Moderate	High	Moderate	Moderate

Ecological evaluations of remedial alternatives included toxicological effects of existing contaminant levels, importance of existing pre-cleanup wetlan and aquatic resources, and the potential effects on these resources on alternative remedial measures. To evaluate the latter, the perceived benefits of pollutant removal were weighed against possible deleterious effects of excavation or containment in wetland and aquatic ecosystems.

Evaluation of excavation impacts assumed implementation of a wetland restoration program, where applicable. Preliminary analyses conducted by WES indicated feasibility of reestablishing appropriate wetland areas, as long as appropriate pre-construction data are collected and appropriate fill selection and placement procedures followed (O'Neil 1988).

Effects of substantial increases in truck traffic on the human environment were also considered in the evaluation of adverse effects of alternative remediation. Although truck-related increases in traffic and noise are secondary relative to health-related impacts, they are considered sufficiently important to warrant inclusion in the alternative evaluation process in this section.

For each alternative, the beneficial effects are assigned, as a group, a single rating of "low," "moderate" or "high," indicative of relative magnitude. Adverse effects of each alternative remedial measure are treated in like fashion. Finally, each alternative is assigned an "Overall Environmental Rating" indicative of its relative favorability.

7.2.1 Remedial Action Subsite 1

7.2.1.1 Alternative 1-1

Beneficial Effects. The no action alternative provides essentially no enhancement of environmental protection. It allows continued migration of contaminants via all pathways, although some protection against direct human contact may be realized by reduction of access to the sites through posting. Endangered species will continue to be exposed to hazardous substances remaining on site.

Adverse Effects. Under the no action alternative, contaminants would continue to migrate from the various contaminated sites through the pathways described in Section 3. The areal extent of contamination would increase and spread into Suisun Bay. The potential for migration was documented by Coats (1986). While the concentrations of contaminants might be attenuated by natural dilution processes, a wider range of fish and wildlife will be exposed to contaminants. In addition, the potential for large discharges of sediment sorbed contaminants will continue to exist whenever a storm or abnormal high tides occur at NWS Concord (Coats 1986). Such events will eventually expose fish in Suisun Bay to hazardous substances. The potential adverse environmental effects of the no action alternative are addressed in Lee et al. (1985, 1986, 1988).

7.2.1.2 Alternative 1-2

Beneficial Effects. The environmental monitoring alternative provides only limited positive environmental protection benefits above those provided by the no-action alternative. The environmental monitoring alternative will not eliminate or mitigate contamination of surface waters, soils, or sediments by continued migration of contaminants from those areas of identified high contaminant concentrations. The implementation of an environmental monitoring program will provide documentation of continued contaminant migration and its associated environmental impact. Wildlife studies will document species use of the site, the contamination of collected species, and problems caused by continued exposure to the hazardous substances remaining on site. The environmental monitoring program will also provide an early warning of changes in conditions that may increase the potential for substantial environmental damage by continued contaminant release or an unexpected increase in the rate of release.

Adverse Effects. Under the environmental monitoring alternative, contaminants will continue to migrate from the areas of major contamination and the areal extent of contamination will continue to expand. However, there will be some attenuation of the high contamination levels because of dilution effects. The potential environmental effects are essentially the same as those found in the no action alternative which are fully addressed in Lee, et al. (1985, 1986,

1988). The threat of contamination of plants and wildlife including endangered species will continue and will increase because of the project 1 increase in the areal extent of contamination.

7.2.1.3 Alternative 1-3A

Beneficial Effects. The excavation and disposal in existing landfills alternative would provide a high level of environmental protection. Contamination will be removed from RASS 1 and placed in a secure environment. In the long term, natural regrowth augmented by the active wetland restoration program would result in full recovery of the wetland. It is estimated that this recovery process will take five years. Beneficial effects are discussed in the biological assessment prepared by O'Neil (1988).

Adverse Effects. The excavation alternative presents the potential for adverse environmental effects caused by exposure of construction personnel and persons located off site to the excavated material during transportation. The excavation of contaminated material will also impact the important wetland habitat found on RASS 1 and will impact resident wildlife populations by death or displacement. In the short term, the habitat will be either mudflat or standing water, depending on elevation and drainage. Neither of these types will provide habitat for the protected species currently on site (Lee et al. 1986). These adverse short term impacts will be mitigated by the potential for long term recovery of the area once the contaminated material is removed and the restoration element of the alternative is implemented. Adverse effects are discussed in the biological assessment prepared by O'Neil (1988).

The disposal in existing landfills option has the additional risk of exposure of the public to contaminated material during the transport of the materials to the disposal area. It is estimated that approximately 1,133 truck loads of material would be removed from RASS 1. Concerns over traffic impacts can be minimized if the rail transport option is selected. It is estimated that approximately 319 rail cars of material would be removed. In addition, there may be some potential for adverse impacts associated with final disposal in a landfill. This possibility will be minimized by selection of an appropriate class of landfill for final disposal.

7.2.1.4 Alternative 1-3C

Beneficial Effects. The beneficial effects of this alternative will be essentially the same as those provided by alternative 1-3A.

Adverse Effects. The adverse effects of this alternative will be essentially the same as those provided by alternative 1-3A. Concerns over the transport of contaminated materials will be reduced by the use of a chemical stabilization process to immobilize the metals in the soil mass. However, the chemical stabilization process will increase the volume of materials requiring disposal by approximately thirty percent with a corresponding increase in truck traffic. Approximately 1473 truck loads of stabilized materials would require transport.

7.2.1.6 Alternative 1-3D

Beneficial Effects. The beneficial effects of this alternative will be essentially the same as those provided by alternative 1-3A.

Adverse Effects. The adverse effects of this alternative will be essentially the same as those provided by alternative 1-3A. However, concerns about transport of contaminated materials will be minimized because the contaminants will be immobilized in the soil matrix and final disposal will occur on NWS Concord. The volume of materials will be increased by the chemical stabilization process by approximately thirty percent.

Approximately ten acres on NWS Concord would be used for construction of a monofill. There is a potential loss of this area for future beneficial use. The monofill would be sited in areas that are more environmentally secure than the wetlands found in RASS 1.

7.2.1.6 Alternative 1-3E

Beneficial Effects. The beneficial effects of this alternative will be essentially the same as those provided by alternative 1-3A.

Adverse Effects. The adverse effects of this alternative will be essentially the same as those provided by alternative 1-3A. Concerns over the off-si : transport of contaminated materials will be minimized by the use of a chemical soil washing process to remove the contaminants from the soil mass. However, the soil washing process produces a concentrated waste stream that must be properly handled, including Class I disposal. It is estimated that approximately 1134 truck loads of decontaminated soil and 162 trucks (46 rail cars) of residual sludges would be transported to existing landfills.

7.2.1.7 Alternative 1-3F

Beneficial Effects. The beneficial effects of this alternative will be essentially the same as those provided by alternative 1-3A.

Adverse Effects. The adverse effects of this alternative will be essentially the same as those provided by alternative 1-3A. However, concerns about transport of contaminated materials will be reduced because the decontaminated soils would be disposed of on-site. A concentrated waste stream of contaminants would be treated and transported to existing landfills for disposal in a Class I facility. Approximately 162 trucks (46 rail cars) of material would require transport to an existing landfill.

7.2.1.8 Summary of Environmental Considerations Analysis for RASS 1

A summary of the environmental considerations analysis for alternative remedial actions considered for RASS 1 is presented in Table 7.10.

7.2.2 Remedial Action Subsite 2

7.2.2.1 Alternative 2-1

Beneficial Effects. The no action alternative provides only limited enhancement of environmental protection. It allows continued migration of contaminants from the various contaminated areas through the pathways described in Section 3. The areal extent of contamination would increase and spread into Suisun Bay. While the concentrations of contaminants might be attenuated by

Table 7.10

Environmental Impacts Evaluation of Alternatives for RASS 1

Evaluation Criteria

Alternative	Beneficial Effects	Rating	Adverse Effects	Rating	Mitigation	Overall Environmental Rating
1-1: No Action	Limited reduction of direct exposure.	Low	Continued transport of contaminants and bioaccumulation.	High	None	Low
1-2: Environmental Monitoring	Limited reduction of direct exposure; ability to detect migration.	Low	Same as 1-1	High	None	Low
1-3A: Excavation/Disposal At Existing Landfills	Removal of contaminants; decreased migration; decreased bioaccumulation.	High	Heavy truck traffic off-site short term impacts on wetland.	Moderate	Restoration of wetlands	High
1-3C: Excavation/Immobilization/ Disposal At Existing Landfills	Same as 1-3A plus contaminant immobilization.	High	Same as 1-3A	Moderate	Same as 1-3A	High
1-3D: Excavation/Immobilization/ Disposal at Monofill on NWS Concord	Same as 1-3C.	High	Same as 1-3A	Moderate	Same as 1-3A	High
1-3E: Excavation/Soil Washing/ Disposal At Existing Landfill	Same as 1-3A.	High	Same as 1-3A generates concentrated waste stream.	Moderate	Same as 1-3A	Moderate
1-3F: Excavation/Soil Washing/ Disposal At Monofill on NWS Concord	Same as 1-3A.	High	Same as 1-3A generates concentrated waste stream.	Moderate	Same as 1-3A	Moderate

natural dilution processes, a wider range of fish and wildlife will be exposed to contaminants. This potential migration was documented by Coats (1986) In addition, the potential for large discharges of sediment sorbed contaminants will continue to exist whenever a storm or abnormal high tides occur at NWS Concord (Coats 1986). Such events will eventually expose fish in Suisun Bay to hazardous substances.

Adverse Impacts. The potential adverse environmental effects of the no action alternative are addressed in Lee, et al. (1985, 1986, 1988).

7.2.2.2 Alternative 2-2

Beneficial Effects. The environmental monitoring alternative provides only limited positive environmental protection benefits above those provided by the no-action alternative. The environmental monitoring alternative will not eliminate or mitigate contamination of surface waters, soils, or sediments by continued migration of contaminants from those areas of identified high contaminant concentrations. The implementation of an environmental monitoring program will provide documentation of continued contaminant migration and its associated environmental impact. Wildlife studies will document species use of the site, the contamination of collected species, and problems caused by continued exposure to the hazardous substances remaining on site. The environmental monitoring program will also provide an early warning of changes in conditions that may increase the potential for substantial environmental damage by continued contaminant release or an unexpected increase in the rate of release.

Adverse Effects. Under the increased monitoring alternative, contaminants will continue to migrate from the areas of major contamination and the areal extent of contamination will continue to expand. However, there will be some attenuation of the high contamination levels because of dilution effects. The potential environmental effects are essentially the same as those found in the no action alternative which are fully addressed in Lee, et al. (1985, 1986, 1988a). The threat of contamination of plants and wildlife including endangered species will continue and will increase because of the projected increase in the areal extent of contamination.

7.2.2.3 Alternative 2-3A

Beneficial Effects. The excavation and disposal in existing landfills alternative would provide a high level of environmental protection. Contamination would be removed from RASS 2 and placed in a secure environment. In the long term, natural regrowth augmented by the active restoration program would result in full recovery of the wetland. It is estimated that this recovery process will take five years. Beneficial effects are discussed in the biological assessment prepared by O'Neil (1988).

Adverse Effects. The excavation alternative presents the potential for adverse environmental effects caused by exposure of construction personnel and persons located off site to the excavated material during transportation. The excavation of contaminated material will also impact the important wetland habitat found at RASS 2 and will impact resident wildlife populations by death or displacement. In the short term, the habitat will be either a mudflat or standing water, depending on elevation and drainage. Neither of these types will provide habitat for the protected species currently on site (Lee et al. 1986). These adverse short term impacts will be mitigated by the potential for long term recovery of the area once the contaminated material is removed and the restoration element of the alternative is implemented. Anticipated short term impacts can be minimized by relocating any endangered species. Adverse effects are discussed in the biological assessment prepared by O'Neil (1988).

The disposal in existing landfill option has the additional risk of exposure of the public to contaminated material during the transport of the materials to the disposal area. It is estimated that approximately 479 truck loads of Class I material would be removed from RASS 2. Concerns over traffic impacts can be minimized if the rail transport option is selected. It is estimated that approximately 135 rail car loads of Class I materials would be removed. In addition, there may be some potential for adverse impacts associated with final disposal in a landfill. This possibility will be minimized by selection of an appropriate class of landfill for final disposal.

7.2.2.4 Alternative 2-3C

Beneficial Effects. The beneficial effects of this alternative will be essentially the same as those provided by alternative 2-3A.

Adverse Effects. The adverse effects of this alternative will be essentially the same as those provided by alternative 2-3A. Concerns over the off-site transport of contaminated materials will be reduced by the use of a chemical stabilization process to immobilize the metals in the soil mass. However, the chemical stabilization process will increase the volume of material requiring disposal by approximately thirty percent with a corresponding increase in truck traffic. Approximately 667 truck loads of stabilized material would be transported.

7.2.2.5 Alternative 2-3D

Beneficial Effects. The beneficial effects of this alternative will be essentially the same as those provided by alternative 2-3A.

Adverse Effects. The adverse effects of this alternative will be essentially the same as those provided by alternative 2-3A. However, concerns about off-site transport of contaminated materials will be minimized because the contaminants will be immobilized in the soil matrix and final disposal will occur on NWS Concord. The chemical stabilization process will increase the volume of material approximately thirty percent.

Approximately ten acres on NWS Concord would be used for construction of a monofill. There is a potential for loss of this area for future beneficial use. The monofill would be sited in areas that are more environmentally secure than the wetlands found in RASS 2.

7.2.2.6 Alternative 2-3E

Beneficial Effects. The beneficial effects of this alternative will be essentially the same as those provided by alternative 2-3A.

Adverse Effects. The adverse effects of this alternative will be essentially the same as those provided by alternative 2-3A. Concerns over the off-site transport of contaminated materials will be minimized by the use of a chemical soil washing process to remove the contaminants from the soil mass. However, the soil washing process produces a concentrated waste stream that must be properly handled, including Class I disposal. Approximately 96 truck loads (27 rail cars) of Class I materials and 524 truck loads of Class III or unrestricted materials would require transport to existing landfills.

7.2.2.7 Alternative 2-3F

Beneficial Effects. The beneficial effects of this alternative will be essentially the same as those provided by alternative 2-3A.

Adverse Effects. The adverse effects of this alternative will be essentially the same as those provided by alternative 2-3A. However, concerns about transport of contaminated materials will be minimized because the decontaminated soils would be disposed of on NWS Concord. A concentrated waste stream of contaminants would be treated and transported for disposal in an existing Class I facility. Approximately 96 truck loads (27 rail cars) of material would require transport to an existing landfill.

7.2.2.8 Summary of Environmental Considerations Analysis for RASS 2

A summary of the environmental considerations analysis for alternatives remedial actions considered for RASS 2 is presented in Table 7.11.

7.2.3 Remedial Action Subsite 3

7.2.3.1 Alternative 3-1

Beneficial Effects. The no action alternative provides only limited enhancement of environmental protection. It allows continued migration of contaminants via all pathways, although some protection against direct human contact may be realized by reduction of access to the sites through posting.

Table 7.11

Environmental Impacts Evaluation of Alternatives for RASS 2

Evaluation Criteria

Alternative	Beneficial Effects	Rating	Adverse Effects	Rating	Mitigation	Overall Environmental Rating
2-1: No Action	Limited reduction of direct exposure.	Low	Continued transport of contaminants and bioaccumulation.	High	None	Low
2-2: Environmental Monitoring	Limited reduction of direct exposure; ability to detect migration.	Low	Same as 2-1.	High	None	Low
2-3A: Excavation/Disposal At Existing Landfills	Removal of contaminants; decreased migration; decreased bioaccumulation.	High	Heavy truck traffic off-site short term impacts on wetland.	Moderate	Restoration of wetlands	High
2-3C: Excavation/ Immobilization/ Disposal At Existing Landfills	Same as 2-3A plus contaminant immobilization.	High	Same as 2-3A.	Moderate	Same as 2-3A	High
2-3D: Excavation/ Immobilization/ Disposal At Monofill on NWS Concord	Same as 2-3C.	High	Same as 2-3A on site landfill.	Moderate	Same as 2-3A	High
2-3E: Excavation/Soil Washing/ Disposal At Existing Landfill	Same as 2-3A.	High	Same as 2-3A generates concentrated waste stream.	Moderate	Same as 2-3A	Moderate
2-3F: Excavation/Soil Washing/ Disposal At Monofill on NWS Concord	Same as 2-3A.	High	Same as 2-3D generates concentrated waste stream.	Moderate	Same as 2-3A	Moderate

Adverse Effects. Under the no action alternative, contaminants would continue to migrate from the various contaminated sites through the pathways described in Section 3. The areal extent of contamination would increase and spread into RASS 1, RASS 2, and eventually into Suisun Bay. While the concentrations of contaminants might be attenuated by natural dilution processes, a wider range of fish and wildlife, including endangered species on RASS 1 and RASS 2, will be exposed to contaminants. In addition, the potential for large discharges of sediment sorbed contaminants will continue to exist whenever a storm event occurs at NWS Concord. Such events potentially expose endangered species in RASS 1 and RASS 2 to hazardous substances. In addition, aquatic organisms in Suisun Bay would eventually be exposed to these materials. The potential adverse environmental effects of the no action alternative are addressed in Lee, et al. (1985, 1986, 1988).

7.2.3.2 Alternative 3-2

Beneficial Effects. The environmental monitoring alternative provides only limited positive environmental protection benefits above those provided by the no-action alternative. The environmental monitoring alternative will not eliminate or mitigate contamination of surface waters, soils, or sediments by continued migration of contaminants from those areas of identified high contaminant concentrations. The implementation of an environmental monitoring program will, however, provide documentation of continued contaminant migration and its associated environmental impact. Wildlife studies will document species use of the site, the contamination of collected species, and problems caused by continued exposure to the hazardous substances remaining on site. The environmental monitoring program will also provide an early warning of changes in conditions that may increase the potential for substantial environmental damage by continued contaminant release or an unexpected increase in the rate of release.

Adverse Effects. Under the increased monitoring alternative, contaminants will continue to migrate from the areas of major contamination and the areal extent of contamination will continue to expand. However, there will be some attenuation of the high contamination levels because of dilution effects. The potential environmental effects are essentially the same as those found in the

no action alternative which are fully addressed in Lee, et al. (1985, 1986, 1988). The threat of contamination of downstream plants and wildlife including endangered species will continue and will increase because of the projected increase in the areal extent of contamination.

7.2.3.3 Alternative 3-3A

Beneficial Effects. The excavation and disposal in existing landfills alternative would provide a high level of environmental protection. Contamination will be removed from RASS 3 and placed in a secure environment. In the long term, natural regrowth would result in full recovery of the wetland. It is estimated that this recovery process will take two years.

Adverse Effects. The excavation alternative presents the potential for adverse environmental effects caused by exposure of construction personnel and persons located off site to the excavated material during transportation. The excavation of contaminated material will also impact habitat found at RASS 3 and will impact resident wildlife populations by death or displacement. Over time, the site of the excavation will silt in and vegetation will recolonize. These adverse short term impacts will be mitigated by the potential for long term recovery of the area once the contaminated material is removed.

The disposal in existing landfills option has the additional risk of exposure of the public to contaminated material during the transport of the materials to the disposal area. It is estimated that approximately 747 truck loads of material would require transport to existing landfills. Based on current data, these materials include 241 loads of Class I material and 506 loads of Class III or unrestricted materials. Concerns over transportation impacts would be reduced if the rail transport option is selected. Under this option, 68 rail car loads of Class I materials would be transported and 506 truck loads of Class III or unrestricted materials would be transported. In addition, there may be some potential for adverse impacts associated with final disposal in a landfill. This possibility will be minimized by selection of an appropriate class of landfill for final disposal.

7.2.3.4 Alternative 3-3C

Beneficial Effects. The beneficial effects of this alternative will be essentially the same as those provided by alternative 3-3A.

Adverse Effects. The adverse effects of this alternative will be essentially the same as those provided by alternative 3-3A. Concerns over the transport of contaminated materials will be reduced by the use of a chemical stabilization process to immobilize the metals in the soil mass. The chemical stabilization process increases the volume of materials by approximately thirty percent. Approximately 819 truck loads of materials would be transported to existing landfills.

7.2.3.5 Alternative 3-3D

Beneficial Effects. The beneficial effects of this alternative will be essentially the same as those provided by alternative 3-3A.

Adverse Effects. The adverse effects of this alternative will be essentially the same as those provided by alternative 3-3A. Concerns about transport of contaminated materials will be minimized because the contaminants will be immobilized in the soil matrix and final disposal will occur on NWS Concord.

7.2.3.6 Alternative 3-3E

Beneficial Effects. The beneficial effects of this alternative will be essentially the same as those provided by alternative 3-3A.

Adverse Effects. The adverse effects of this alternative will be essentially the same as those provided by alternative 3-3A. Concerns over the transport of contaminated materials will be reduced by the use of a chemical soil washing process to remove the contaminants from the soil mass. However, the soil washing process produces a concentrated waste stream that must be properly handled, including Class I disposal. Approximately 747 loads of Class III materials and 35 loads of Class I materials would require truck transport to existing landfills.

7.2.3.7 Alternative 3-3F

Beneficial Effects. The beneficial effects of this alternative will be essentially the same as those provided by alternative 3-3A.

Adverse Effects. The adverse effects of this alternative will be essentially the same as those provided by alternative 3-3A. However, concerns about transport of contaminated materials will be minimized because the decontaminated soils would be disposed of on NWS Concord. A concentrated waste stream of contaminants would be treated and transported for disposal in an existing Class I facility.

7.2.3.8 Summary of Environmental Considerations Analysis for RASS 3

A summary of the environmental considerations analysis for alternative remedial actions proposed for RASS 3 is presented in Table 7.12.

7.2.4 Remedial Action Subsite 4

7.2.4.1 Alternative 4-1

Beneficial Effects. The no action alternative provides only limited enhancement of environmental protection. It allows continued migration of contaminants via all pathways, although some protection against direct human contact may be realized by reduction of access to the sites through posting. Plant and wildlife species will continue to be exposed to toxic materials remaining on site.

Adverse Effects. Under the no action alternative, contaminants would continue to migrate through the pathways described in Section 3. The areal extent of contamination would increase. While the concentrations of contaminants might be attenuated by natural dilution processes a wider range of plant and wildlife will be exposed to contaminants. The potential exists for contaminant migration whenever a storm event occurs at NWS Concord. The potential environmental effects of the no action alternative are addressed in Lee, et al. (1985, 1986).

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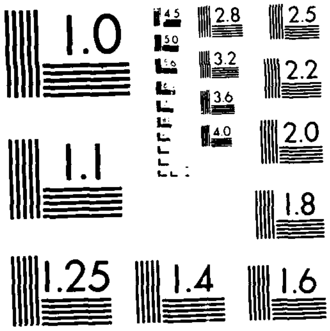
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1.25
1.4
1.6

Table 7.12

Environmental Impacts Evaluation of Alternatives for RASS 3

Evaluation Criteria

Alternative	Beneficial Effects	Rating	Adverse Effects	Rating	Mitigation	Overall Environmental Rating
3-1: No Action	Limited reduction of direct exposure.	Low	Continued transport of contaminants and bioaccumulation.	High	None	Low
3-2: Environmental Monitoring	Limited reduction of direct exposure; ability to detect migration.	Low	Same as 3-1.	High	None	Low
3-3A: Excavation/Disposal At Existing Landfills	Removal of contaminants; decreased migration; decreased bioaccumulation.	High	Heavy truck traffic off-site short term impacts on wetland.	Moderate	Restoration of wetlands	High
3-3C: Excavation/ Immobilization/ Disposal At Existing Landfills	Same as 3-3A plus contaminant immobilization.	High	Same as 3-3A.	Moderate	Same as 3-3A	High
3-3D: Excavation/ Immobilization/ Disposal at Monofill on NWS Concord	Same as 3-3C.	High	Same as 3-3A on site landfill.	Moderate	Same as 3-3A	High
3-3E: Excavation/Soil Washing/ Disposal At Existing Landfill	Same as 3-3A.	High	Same as 3-3A generates concentrated waste stream.	Moderate	Same as 3-3A	Moderate
3-3F: Excavation/Soil Washing/ Disposal At Monofill on NWS Concord	Same as 3-3A.	High	Same as 3-3D generates concentrated waste stream.	Moderate	Same as 3-3A	Moderate

7.2.4.2 Alternative 4-2

Beneficial Effects. The environmental monitoring alternative provides only limited positive environmental protection benefits above those provided by the no-action alternative. The environmental monitoring alternative will not eliminate or mitigate contamination of surface waters, soils, or sediments by continued migration of contaminants from those areas of identified high contaminant concentrations. The implementation of an environmental monitoring program will provide documentation of continued contaminant migration and its associated environmental impact. Wildlife studies will document species use of the site, the contamination of collected species, and problems caused by continued exposure to the hazardous substances remaining on site. The environmental monitoring program will also provide an early warning of changes in conditions that may increase the potential for substantial environmental damage by continued contaminant release or an unexpected increase in the rate of release.

Adverse Effects. Under the environmental monitoring alternative, contaminants will continue to migrate from the area of major contamination and the areal extent of contamination will continue to expand. However, there will be some attenuation of the high contamination levels because of dilution effects. The potential environmental effects are essentially the same as those found in the no action alternative which are fully addressed in Lee, et al. (1985, 1986, 1988). The threat of contamination of plants and wildlife will continue and will increase because of the projected increase in the areal extent of contamination.

7.2.4.3 Alternative 4-3A

Beneficial Effects. The excavation and off site disposal alternative should provide a high level of environmental protection. Contamination will be removed from RASS 4 and placed in a secure environment.

Adverse Effects. The excavation alternative presents the potential for adverse environmental effects caused by exposure to the excavated material of construction personnel and persons located off site during transportation.

The excavation of contaminated material will also impact habitat found on RASS 4 and will impact resident wildlife populations by death or displacement. These adverse short term impacts will be mitigated by the potential for long term recovery of the area once the contaminated material is removed.

The disposal in existing landfills option has the additional risk of exposure of the public to contaminated material during the transport of the materials to the disposal area. Approximately 71 truck loads of Class I materials would require truck transport to existing landfills. In addition, there may be some potential for adverse impacts associated with final disposal in a landfill. This possibility will be minimized by selection of an appropriate class of landfill for final disposal.

7.2.4.4 Alternative 4-3C

Beneficial Effects. The beneficial effects of this alternative will be essentially the same as those provided by alternative 4-3A.

Adverse Effects. The adverse effects of this alternative will be essentially the same as those provided by alternative 4-3A. Concerns over the off-site transport of contaminated materials will be reduced by the use of a chemical stabilization process to immobilize the metals in the soil mass. The chemical stabilization process increases the volume of materials by approximately thirty percent. Approximately 92 truck loads of materials would be transported to existing landfills.

7.2.4.5 Alternative 4-3D

Beneficial Effects. The beneficial effects of this alternative will be essentially the same as those provided by alternative 4-3A.

Adverse Effects. The adverse effects of this alternative will be essentially the same as those provided by alternative 4-3A. However, concerns about transport of contaminated materials will be minimized because the contaminants will be immobilized in the soil matrix and final disposal will occur on NWS Concord.

7.2.4.6 Alternative 4-3E

Beneficial Effects. The beneficial effects of this alternative will be essentially the same as those provided by alternative 4-3A.

Adverse Effects. The adverse effects of this alternative will be essentially the same as those provided by alternative 4-3A. Concerns over the off-site transport of contaminated materials will be reduced by the use of a chemical soil washing process to remove the contaminants from the soil mass. However, the soil washing process produces a concentrated waste stream that must be properly handled, including Class I disposal. Approximately 71 truck loads of Class III and 11 truck loads of Class I materials will require transport to existing landfills.

7.2.4.7 Alternative 4-3F

Beneficial Effects. The beneficial effects of this alternative will be essentially the same as those provided by alternative 4-3A.

Adverse Effects. The adverse effects of this alternative will be essentially the same as those provided by alternative 4-3A. However, concerns about off-site transport of contaminated materials will be eliminated because the decontaminated soils would be disposed of on-site. A concentrated waste stream of contaminants would be treated and transported off-site for disposal in a Class I facility. Approximately 11 truck loads would require transport to an existing Class I landfill.

7.2.4.8 Alternative 4-4A

Beneficial Effects. This alternative would reduce the possibility for contaminant migration into adjacent areas. Containment would also protect flora and fauna from direct contact with the contaminants. Containment, however, is not considered as reliable as removal, and monitoring of containment structures would be required. Beneficial effects are therefore considered to be moderate.

Adverse Effects. The soil cover will raise the ground surface elevation a minimum of four ft. Because of the relatively insensitive environment found on RASS 4, this is not anticipated to cause significant adverse impacts. There will, however, be significant disruption of the existing habitat during construction activities.

The overall environmental rating for this alternative is moderate.

7.2.4.9 Alternative 4-4B

Beneficial Effects. This alternative would reduce the possibility for contaminant migration into adjacent areas as well as the prevention of possible migration into underlying ground water. Containment would also protect flora and fauna from direct contact with the contaminants. Containment, however, is not considered as reliable as removal, and monitoring of containment structures would be required. Beneficial effects are therefore considered to be moderate.

Adverse Effects. The RCRA cover will raise the ground surface elevation a minimum of six ft. Because of the relatively insensitive environment found on RASS 4, this is not anticipated to cause significant adverse impacts. There will, however, be significant disruption of the existing habitat during construction activities.

7.2.4.10 Summary of Environmental Considerations Analysis for RASS 4

A summary of the environmental considerations analysis for potential RASS 4 remedial action alternatives is presented in Table 7.13.

7.3 Institutional Requirements

This section presents a discussion and evaluation of the institutional concerns regarding the NWS Concord site remedial action alternatives presented in Section 6.0. These concerns are divided into four categories: conformance to ARAR, permitting requirements; legal constraints, if any; and impacts on historic and cultural resources. A general discussion of the ARAR's followed by a specific analysis of how they apply to each alternative is presented below.

Table 7.13

Environmental Impacts Evaluation of Alternatives for RASS 4

Evaluation Criteria

Alternative	Beneficial Effects	Rating	Adverse Effects	Rating	Mitigation	Overall Environmental Rating
4-1: No Action	Limited reduction of direct exposure.	Low	Continued transport of contaminants and bioaccumulation.	High	None	Low
4-2: Environmental Monitoring	Limited reduction of direct exposure; ability to detect migration.	Low	Same as 4-1.	High	None	Low
4-3A: Excavation/Disposal At Existing Landfills	Removal of contaminants; decreased migration; decreased bioaccumulation.	High	Heavy truck traffic off-site short term impacts on wetland.	Moderate	Restoration of wetlands	High
4-3C: Excavation/ Immobilization/Disposal At Existing Landfills	Same as 4-3A plus contaminant immobilization.	High	Same as 4-3A.	Moderate	Same as 4-3A	High
4-3D: Excavation/ Immobilization/Disposal at Monofill on NWS Concord	Same as 4-3C.	High	Same as 4-3A. Plus operation of on-site landfill.	Moderate	Same as 4-3A	High
4-3E: Excavation/Soil Washing/ Disposal At Existing Landfill	Same as 4-3A.	High	Same as 4-3A generates concentrated waste stream.	Moderate	Same as 4-3A	Moderate
4-3F: Excavation/Soil Washing/ Disposal At Monofill on NWS Concord	Same as 4-3A.	High	Same as 4-3D generates concentrated waste stream.	Moderate	Same as 4-3A	Moderate
4-4A: Source Isolation/Soil Cap	Containment of contamination; decreased surface migration; decreased bioaccumulation.	Moderate	Disruption to existing wildlife and plant life.	Moderate	None	Moderate
4-4B: Source Isolation/RCRA Cap	Containment of contamination; decreased surface and vertical migration; decreased bioaccumulation.	Moderate	Same as 4-4A.	Moderate	None	Moderate

USEPA (1987) provides general guidance in the selection of ARAR's. A brief summary of the potential ARARs was presented in Section 3.3.1. The final selection of ARARs is site specific. The major ARAR's selected for application to the potential remedial actions subsites at NWS Concord are discussed below. This analysis is limited to the statutory ARARs. It is presumed that all regulations, criteria, advisories, and guidance issued pursuant to these statutory requirements are implicitly included as ARARs under the selected statutory ARAR. ARARs identified to date are discussed briefly below.

7.3.1 Remedial Action Subsite 1

7.3.1.1 Alternative 1-1

ARAR's identified for RASS 1 are summarized in Table 7.14

Conformance To ARAR

Executive Order 11,990. Executive Order 11,990 requires that the destruction, loss, or degradation of wetlands be minimized and the natural and beneficial values of wetlands be enhanced in the management of Federal lands. Since RASS 1 contains a significant amount of brackish water wetlands (115.07 acres), Executive Order 11,990 concerning protection of wetlands is an applicable requirement for RASS 1. The no action alternative leaves significant levels of contamination on RASS 1 and is expected to continue to have adverse impacts on the animal and vegetative populations on the RASS. Alternative 1-1 does not conform to this ARAR.

Resource Conservation and Recovery Act (RCRA). The Resource Conservation and Recovery Act regulates the treatment, storage, and disposal of hazardous wastes. Although RASS 1 is not a RCRA site, the requirements of RCRA are relevant and appropriate to the concept of leaving contamination on-site. The RCRA requirements on closure and post-closure care of RCRA facilities in general, and landfills in particular, contain requirements affecting this alternative. These include requirements addressing post-closure care, property use, maintenance of site security, and monitoring (40 CFR 264 Subpart G). Alternative 1-1 does not conform to this ARAR.

Table 7.14

Summary of ARAR's Analysis for RASS 1

	FCWA* (404)	FCWA* (402)	SWDA*	ESA* (7)	ESA* (9)	SDWA*	RHA*	E.O.* 11,990	E.O.* 11,988	CHSC*	CWC*	CFGC*	CPRC*
Locational													
Upland													
Waters											A	R	
Stream											R		
Wetlands	R							A	A		R		
Adjacent to Bay	R							A	A		R		
Adjacent to Stream	R							A	A		R		
Endangered Species Habitat				A	A							A	
Other Habitat													
Chemicals													
Arsenic		R	R			R				R	R	R	
Cadmium		R	R			R				R	R	R	
Copper		R	R			R				R	R	R	
Lead		R	R			R				R	R	R	
Selenium		R	R			R				R	R	R	
Zinc		R	R			R				R	R	R	
Remedial Action													
Excavation of Soil													
From Upland													
From Wetland													
From Endangered Species								A	A			A	
Habitat				A	A								
From Other Habitat													
Removal of Soil								A	A				A
Off-site Transport of Soil													
Off-site Disposal of Soil			A							A			
Backfilling in Wetlands	A							A	A		A	R	A
Backfilling in Uplands									A				

* FCWA = Federal Clean Water Act
SWDA = Solid Waste Disposal Act
ESA = Endangered Species Act
SDWA = Safe Drinking Water Act
RHA = Rivers & Harbors Act

E.O. = Executive Order
CHSC = California Health & Safety Code
CWC = California Water Code
CFGC = California Fish & Game Code
CPRC = California Public Resources Code

A = Applicable
R = Relevant or Appropriate
() = *Operative Section*

Endangered Species Act. The Endangered Species Act prohibits the taking of any endangered species, and requires that actions not be likely to jeopardize the continued existence of any endangered species or result in the destruction or adverse modification of the critical habitat of such species. Because RASS 1 includes significant habitat for endangered species, the Endangered Species Act is an applicable requirement for RASS 1. Failure to remove known high levels of contamination would have an adverse impact on these species. Alternative 1-1 does not conform to this ARAR.

The Clean Water Act. The Clean Water Act regulates the discharge of pollutants from point sources into the navigable waters of the United States. Because RASS 1 contains brackish water wetlands and streams, the requirements of the Clean Water Act are relevant and appropriate. Data collected during the RI documented the migration of contamination through the surface water pathway. Concentrations of metals in excess of ambient water quality standards were documented. Leaving the contaminants in-place will result in the continued migration of metals into the surface water. Alternative 1-1 does not conform to this ARAR.

California Water Code. The California Water Code regulates the discharge of hazardous wastes into the waters of the State. Because RASS 1 contains brackish water wetlands and streams, the requirements of the California Water Code are relevant and appropriate. Data collected during the RI indicated that there was a discharge of hazardous waste into the streams and wetlands in the RASS 1 area. This discharge was found to be in excess of the water quality standards. Alternative 1-1 does not conform to this ARAR.

California Health and Safety Code. The California Health and Safety Code provides guidance on the identification of hazardous materials through the use of the TTLC/STLC criteria. Because the TTLC/STLC criteria provide such guidance, the TTLC/STLC criteria are relevant and appropriate. Materials exceeding these criteria have been identified on RASS 1 and would be left in place under this alternative. Alternative 1-1 does not conform to this ARAR.

The California Fish and Game Code. The California Fish and Game Code prohibits the deposition of substances or materials where such substances or materials can pass into waters of the State of California that would have a detrimental effect on wildlife, and prohibits the taking of any endangered or threatened species of wildlife. Because RASS 1 includes significant habitat for endangered species, the requirements of the California Fish and Game Code are relevant and appropriate. Data collected in the RI indicated that there was a discharge of such substances or materials into RASS 1. Alternative 1-1 does not conform to this ARAR.

Based on present understanding of the relevant facts, it is anticipated that Alternative 1-1 will be unable to attain ARAR's primarily because of the substantial quantities of contaminated materials left on RASS 1. The ARAR conformance rating for Alternative 1-1 is low.

Permitting Requirements. No permitting requirements have been identified to date for Alternative 1-1. Since no permitting requirements have been identified, the permit requirement rating of Alternative 1-1 is high.

Legal Constraints. Because contamination is left in-place, the ESA may present obstacles to the acceptance of this alternative. Therefore, the legal constraint rating for Alternative 1-1 rating is low.

Cultural Resources. No significant cultural resources would be impacted by Alternative 1-1.

Based on the evaluations presented above, the overall institutional rating for Alternative 1-1 is low.

7.3.1.2 Alternative 1-2

Conformance To ARAR

Executive Order 11,990. Executive Order 11,990 requires that the destruction, loss, or degradation of wetlands be minimized and the natural and beneficial values of wetlands be enhanced in the management of Federal lands. Since RASS 1 contains a significant amount of brackish water wetlands

(115.07 acres), Executive Order 11,990 concerning protection of wetlands is an applicable requirement for RASS 1. The environmental protection alternative leaves significant levels of contamination on RASS 1 and is expected to continue to have adverse impacts on the animal and vegetative populations on the RASS. Implementation of an extensive environmental monitoring program will aid in the identification and evaluation of adverse impacts; however, such a monitoring program will not remove existing contamination nor prevent the continued migration of contamination. Alternative 1-2 does not conform to this ARAR.

Resource Conservation and Recovery Act (RCRA). The Resource Conservation and Recovery Act regulates the treatment, storage, and disposal of hazardous wastes. Although RASS 1 is not a RCRA site per se, RCRA requirements on closure and post-closure care of RCRA facilities in general, and landfills in particular, contain requirements that are relevant and appropriate to this alternative. These include requirements addressing post-closure care, property use, maintenance of site security, and monitoring (40 CFR 264 Subpart G). Although this alternative may be designed to meet most of these concerns, the fact that significant levels of contamination will be allowed to remain on-site may raise significant RCRA concerns. Alternative 1-2 would only partially conform to this ARAR.

Endangered Species Act. The Endangered Species Act prohibits the taking of any endangered species, and requires that actions not be likely to jeopardize the continued existence of any endangered species or result in the destruction or adverse modification of the critical habitat of such species. Because RASS 1 includes significant habitat for endangered species, the Endangered Species Act is an applicable requirement for RASS 1. Failure to remove known high levels of contamination would have an adverse impact on these species. Although the environmental monitoring alternative will document these impacts, the impacts will continue to occur. Alternative 1-2 will only partially conform to this ARAR.

Clean Water Act. The Clean Water Act regulates the discharge of pollutants from point sources into the navigable waters of the United States. Because RASS 1 contains brackish water wetlands and streams, the requirements of the Clean Water Act are relevant and appropriate. Data collected during the RI

documented the migration of contamination through the surface water pathway. Concentrations of metals in excess of ambient water quality standards were documented. Leaving the contaminants in-place will result in the continued migration of metals into the surface water. Monitoring will provide information on the migration of contaminants; however, monitoring will not prevent the continued migration of contamination. Alternative 1-2 does not conform to this ARAR.

California Water Code. The California Water Code regulates the discharge of hazardous waste into the waters of the State of California. Because RASS 1 contains brackish water wetlands and streams, the requirements of the California water Code are relevant and appropriate. Data collected during the RI indicated that there was a discharge of hazardous substances into the streams and wetlands in the RASS 1 area. This discharge was found to be in excess of the water quality standards. An extensive monitoring program would enable the evaluation of contaminant migration through the surface water pathway; however, it would not prevent such migration. Alternative 1-2 does not conform to this ARAR.

California Health and Safety Code. The California Health and Safety Code provides guidance on the identification of hazardous materials through the use of the TTLC/STLC criteria. Because the TTLC/STLC criteria provide such guidance, the TTLC/STLC criteria are relevant and appropriate. Materials exceeding these criteria have been identified on RASS 1 and would be left in place under this alternative. Alternative 1-2 may not conform to this ARAR.

The California Fish and Game Code. The California Fish and Game Code prohibits the deposition of substances or materials where such substances or materials can pass into waters of the State of California that would have a detrimental effect on wildlife, and prohibits the taking of any endangered or threatened species of wildlife. Because RASS 1 includes significant habitat for endangered species, the requirements of the California Fish and Game Code are relevant and appropriate. Data collected in the RI indicated that there was a discharge of such substances or materials into RASS 1. The monitoring program would provide detailed information on the environmental effects of the hazardous substances that have been discharged onto RASS 1, however, would not

prevent continuation of the impacts. Alternative 1-2 would not conform to this ARAR.

Based on present understanding of the relevant facts, it is anticipated that Alternative 1-2 will be unable to attain ARAR's primarily because of the substantial quantities of contaminated materials left on RASS 1. The ARAR conformance rating of Alternative 1-2 is low.

Permitting Requirements. No permitting requirements have been identified to data for Alternative 1-2. Since no permitting requirements have been identified, the permitting requirement rating for Alternative 1-2 is high.

Legal Constraints. The ESA may present obstacles to the acceptance of this alternative. In addition, there is suspected contamination along the boundary of RASS 1 on property that is not owned by the Navy. This property will need to be included in the monitoring program; however, the Navy does not have access to the property. Therefore, the legal constraint rating for Alternative 1-2 is low.

Cultural Resources. No significant cultural resources would be impacted by Alternative 1-2.

Based on the evaluations presented above, the overall institutional rating for Alternative 1-2 is low.

7.3.1.3 Alternative 1-3A

Conformance To ARAR

Executive Order 11,990. Executive Order 11,990 requires that the destruction, loss, or degradation of wetlands be minimized and the natural and beneficial values of wetlands be enhanced in the management of Federal lands. Since RASS 1 contains a significant amount of brackish water wetlands (115.07 acres), Executive Order 11,990 concerning protection of wetlands is an applicable requirement for RASS 1. Excavation and filling activities conducted under this alternative will have a significant impact on the wetlands. Proper design and implementation of safeguards during the construction period

will limit impacts consistent with the balancing of short term and long term impacts. The extent of excavation has been limited by the selection of an active remediation area that contains only the highest level of contamination and takes into account topographic features of the site. A wetland restoration element has been included in this alternative. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and the migration of such contamination. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. The potential for severe short term impacts was a factor in the development of the site specific cleanup criteria for this alternative. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 1-3A conforms to this ARAR.

Rivers and Harbors Act of 1899. The Rivers and Harbors Act of 1899 regulates the excavation and filling of the navigable waters of the United States. Excavation activities areas may fall within the "navigable waters of the United States," regulated under Section 10 of the Rivers and Harbors Act. Balancing of short term and long term impacts is consistent with this ARAR. Alternative 1-3A conforms to this ARAR.

Executive Order 11,988. Executive Order 11,988 requires that the natural and beneficial values of floodplains be restored and preserved in the management of Federal lands. Since RASS 1 contains a significant amount of floodplains, Executive Order 11,988 is an applicable requirement for RASS 1. Excavation and filling activities conducted in the wetlands will be affected by the requirements of Executive Order 11,988 on Floodplain Management. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and the migration of such contamination. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. The potential for severe short term impacts was a factor in the development of the site specific cleanup criteria for this alternative. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 1-3A conforms to this ARAR.

Resource Conservation and Recovery Act (RCRA). The Resource Conservation and Recovery Act regulates the treatment, storage, and disposal of hazardous wastes. Although RASS 1 is not a RCRA site, the requirements of RCRA are relevant and appropriate to the concept of leaving contamination on-site. The RCRA requirements on closure and post-closure care of RCRA facilities in general, and landfills in particular, contain requirements affecting this alternative. These include requirements addressing post-closure care, property use, maintenance of site security, and monitoring (40 CFR 264 Subpart G). Activities conducted under this alternative will be affected by the requirements of 40 CFR 261, 40 CFR 262, and 40 CFR 263. These requirements can be accommodated during the design process by ensuring that all requirements are addressed in project specifications.

Excavation and off-site transportation of contaminated materials will trigger the requirement to meet applicable Department of Transportation regulations. The transport of contaminated materials can be accomplished in accordance with such regulations. Excavation of wetland materials may trigger the RCRA ban on the landfilling of materials containing free liquids. Alternative 1-3A conforms to this ARAR.

Endangered Species Act. The Endangered Species Act prohibits the taking of any endangered species, and requires that actions not be likely to jeopardize the continued existence of any endangered species or result in the destruction or adverse modification of the critical habitat of such species. Because RASS 1 includes significant habitat for endangered species, the Endangered Species Act is an applicable requirement for RASS 1. Excavation of the contaminated materials and filling will result in substantial short term impacts on the habitat and species currently residing on RASS 1. This short term impact will be offset by the long term improvement resulting from the removal of the contamination. The potential for severe short term impacts was a factor in the development of the site specific cleanup criteria for this alternative. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 1-3A conforms to this ARAR.

The Clean Water Act. The Clean Water Act regulates the discharge of pollutants from point sources into the navigable waters of the United States and

regulates the discharge of dredged or fill material from point sources into the waters of the United States. Because RASS 1 contains brackish water wetlands and streams, the requirements of the Clean Water Act which regulate the discharge of pollutants into the navigable waters of the United States are relevant and appropriate and the requirements of the Clean Water Act which regulate the discharge of dredged or fill material into the waters of the United States are applicable. Data collected during the RI indicated that there was a discharge of contaminants into the streams and wetlands in the RASS 1 area. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and migration of such contamination. The extent of the reduction in contaminant migration has not been quantified. Construction activities may result in temporary increases in sediment and contaminant loads to the wetland areas of RASS 1. This possibility can be minimized through adequate design of the selected excavation method. Significant excursions above the Federal Ambient Water Quality Criteria during active remediation are not anticipated. Filling, after excavation, will result in substantial short term impacts to the wetlands. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. Alternative 1-3A partially conforms to this ARAR.

<u>California Water Code</u>. The California Water Code regulates the discharge of hazardous wastes into the waters of the State of California. Because RASS 1 contains brackish water wetlands and streams, the requirements of the California Water Code are relevant and appropriate. Data collected during the RI indicated that there was a discharge of contaminants into the streams and wetlands in the RASS 1 area. This discharge was found to be in excess of the water quality standards. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and migration of such contamination. The extent of the reduction in contaminant migration has not been quantified. There is the possibility for the short term release of contamination during conduct of the remedial action; however, this potential can be minimized through adequate construction planning. Filling, after excavation, will result in substantial short term impacts to the wetlands. The extensive monitoring program would enable the evaluation of contaminant migration through the surface water pathway and impacts on the wetlands. Alternative 1-3A partially conforms to this ARAR.

California Health and Safety Code. The California Health and Safety Code provides guidance on the identification of hazardous materials through the use of the TTLC/STLC criteria. Because the TTLC/STLC criteria provide such guidance, the TTLC/STLC criteria are relevant and appropriate. Materials that exceed these criteria would be disposed of in accordance with appropriate regulations. Some materials that exceed these criteria would be left in place under this alternative. This alternative will conform to this ARAR in respect to materials disposal. Although significant quantities of contaminants are removed by this alternative, some materials exceeding these criteria that would be left on-site. Such materials that are left on site will be evaluated through the extensive monitoring program. Alternative 1-3A partially conforms to this ARAR.

The California Fish and Game Code. The California Fish and Game Code prohibits the deposition of substances or materials where such substances or materials can pass into waters of the State of California that would have a detrimental effect on wildlife, and prohibits the taking of any endangered or threatened species of wildlife. Because RASS 1 includes significant habitat for endangered species, the requirements of the California Fish and Game Code are relevant and appropriate. Data collected in the RI indicated that there was a discharge of such substances or materials into RASS 1. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and the migration of such contamination. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. Alternative 1-3A would conform with this ARAR.

Based on present understanding of the relevant facts, it is anticipated that Alternative 1-3A will be able to attain or partially attain ARAR's. In those cases where partial ARAR's conformance is attained, an environmental impacts waiver has been applied following the balancing of short and long term impacts of remediation with leaving contamination on site. The ARAR conformance rating for Alternative 1-3A is high.

Permitting Requirements. No specific permitting requirements have been identified to date for Alternative 1-3A. However, permits or coordination with appropriate agencies may be required for excavation and filling in

wetlands and transportation of contaminated materials. The permitting requirement rating for Alternative 1-3A is high.

Legal Constraints. The ESA may present obstacles to the acceptance of this alternative. Consultation with appropriate agencies during the preparation of project plans and specifications can ensure that concerns are addressed. Contamination of adjacent properties, not under Navy ownership or control is suspected. The Navy does not have access to remediate this contamination. Therefore, the legal constraint rating for Alternative 1-3A is moderate.

Cultural Resources. No significant cultural resources would be impacted by Alternative 1-3A.

Based on the evaluations presented above, the overall institutional rating for Alternative 1-3A is high.

7.3.1.4 Alternative 1-3C

Conformance To ARAR

Executive Order 11,990. Executive Order 11,990 requires that the destruction, loss, or degradation of wetlands be minimized and the natural and beneficial values of wetlands be enhanced in the management of Federal lands. Since RASS 1 contains a significant amount of brackish water wetlands (115.07 acres), Executive Order 11,990 concerns protection of wetlands is an applicable requirement for RASS 1. Excavation and filling activities conducted under this alternative will have a significant impact on the wetlands. Proper design and implementation of safeguards during the construction period will limit impacts consistent with the balancing of short term and long term impacts. The extent of excavation has been limited by the selection of an active remediation area that contains only the highest level of contamination and takes into account topographic features of the site. A wetland restoration element has been included in this alternative. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and the migration of such contamination. The monitoring program would provide detailed information on the environmental

effects of the remedial action and the contaminants left on-site. The potential for severe short term impacts was a factor in the development of the site specific cleanup criteria for this alternative. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 1-3C conforms to this ARAR.

Rivers ad Harbors Act of 1899. The Rivers and Harbors Act of 1899 regulates the excavation and filling of the navigable waters of the United States. Excavation activities in the wetland areas may fall within the "navigable waters of the United States," regulated under Section 10 of the Rivers and Harbors Act. Alternative 1-3C conforms to this ARAR. Balancing of short term and long term impacts is consistent with this ARAR.

Executive Order 11,988. Executive Order 11,988 requires that the natural and beneficial values of floodplains be restored and preserved in the management of Federal lands. Since RASS 1 contains a significant amount of floodplains, Executive Order 11,988 is an applicable requirement for RASS 1. Excavation and filling activities conducted in the wetlands will be affected by the requirements of Executive Order 11,988 on Floodplain Management. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and the migration of such contamination. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. The potential for severe short term impacts was a factor in the development of the site specific cleanup criteria for this alternative. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 1-3C would conform to this ARAR.

Resource Conservation and Recovery Act (RCRA). The Resource Conservation and Recovery Act regulates the treatment, storage, and disposal of hazardous wastes. Although RASS 1 is not a RCRA site, the requirements of RCRA are relevant and appropriate to the concept of leaving contamination on-site. The RCRA requirements on closure an deposit-closure care of RCRA facilities in general, and landfills in particular, contain requirements affecting this alternative. These include requirements addressing post-closure care, property use, maintenance on site security, and monitoring (40 CFR 264 Subpart G).

The purpose of the on-site stabilization/solidification plant is to immobilize certain metals in the contaminated soils and sediments. Therefore, the regulations governing owners and operators of hazardous waste treatment facilities would be relevant and appropriate. Activities conducted under this alternative will be affected by the requirements of 40 CFR 261, 40 CFR 262, 40 CFR 263, and 40 CFR 264. These requirements can be accommodated during the design process by ensuring that all requirements are addressed in project specifications.

Excavation of wetland materials may trigger the ban on the landfilling of materials containing free liquids. The proposed stabilization/solidification process should eliminate this possibility. Alternative 1-3C would conform to this ARAR.

Endangered Species Act. The Endangered Species Act prohibits the taking of any endangered species, and requires that actions not be likely to jeopardize the continued existence of any endangered species or result in the destruction or adverse modification of the critical habitat of such species. Because RASS 1 includes significant habitat for endangered species, the Endangered Species Act is an applicable requirement for RASS 1. Excavation of the contaminated materials and filling will result in substantial short term impacts on the habitat and species currently residing on RASS 1. This short term impact will be offset by the long term improvement resulting from the removal of the contamination. The potential for severe short term impacts were a factor in the development of the site specific cleanup criteria for this alternative. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 1-3C conforms to this ARAR.

The Clean Water Act. The Clean Water Act regulates the discharge of pollutants from point sources into the navigable waters of the United States and regulates the discharge of dredged or fill material from point sources into the waters of the United States. Because RASS 1 contains brackish water wetlands and streams, the requirements of the Clean Water Act which regulate the discharge of pollutants into the navigable waters of the United States are relevant and appropriate and the requirements of the Clean Water Act which

regulate the discharge of dredged or fill material into the waters of the United States are applicable. Data collected during the RI indicated that there was a discharge of contaminants into the streams and wetlands in the RASS 1 area. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and migration of such contamination. The extent of the reduction in contaminant migration has not been quantified. Construction activities may result in temporary increases in sediment loads to the wetland areas of RASS 1. This possibility can be minimized through adequate design of the selected excavation method. Significant excursions above the Federal Water Quality Criteria during active remediation are not anticipated. Filling, after excavation, will result in substantial short term impacts to the wetlands. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. Alternative 1-3C partially conforms to this ARAR.

California Water Code. The California Water Code regulates the discharge of hazardous wastes into the waters of the State of California. Because RASS 1 contains brackish water wetlands and streams, the requirements of the California Water Code are relevant and appropriate. Data collected during the RI indicated that there was a discharge of contaminants into the streams and wetlands in the RASS 1 area. This discharge was found to be in excess of the water quality standards. The partial removal of contamination proposed by the remedial action involved in this alternative would reduce the amount of contamination on site and migration of such contamination. The extent of the reduction in contaminant migration has not been quantified. There is the possibility for the short term release of contamination during conduct of the remedial action; however, this potential can be reduced through adequate construction planning. Filling, after excavation, will result in substantial short term impacts to wetlands. The extensive monitoring program would enable the evaluation of contaminant migration through the surface water pathway and impacts on the wetlands. Alternative 1-3C partially conforms to this ARAR.

California Health and Safety Code. The California Health and Safety Code provides guidance on the identification of hazardous materials through the use of the TTLC/STLC criteria. Because the TTLC/STLC criteria provide such guidance, the TTLC/STLC criteria are relevant and appropriate. Materials that exceed

these criteria would be disposed of in accordance with appropriate regulations. Some materials that exceed these criteria would be left in place under this alternative. The California Health and Safety Code also affects the treatment and disposal of materials excavated from the RASS. This alternative will conform to this ARAR in respect to materials disposal. Materials exceeding these criteria that are left on-site will be evaluated through the extensive monitoring program. Alternative 1-3C partially conforms to this ARAR.

The California Fish and Game Code. The California Fish and Game Code prohibits the deposition of substances or materials where such substances or materials can pass into waters of the State of California that would have a detrimental effect on wildlife, and prohibits the taking of any endangered or threatened species of wildlife. Because RASS 1 includes significant habitat for endangered species, the requirements of the California Fish and Game Code are relevant and appropriate. Data collected in the RI indicated that there was a discharge of such substances or materials into RASS 1. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and the migration of such contamination. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. Although some contamination will be left on-site, Alternative 1-3C would conform to this ARAR.

Based on present understanding of the relevant facts, it is anticipated that Alternative 1-3C will be able to attain or partially attain ARAR's. In those cases where partial ARAR's conformance is attained, an environmental impacts waiver has been applied following the balancing of short and long term impacts of remediation with leaving contamination on site. The ARAR conformance rating of Alternative 1-3C is high.

Permitting Requirements. To date, no specific permitting requirements have been identified for Alternative 1-3C. However, permits or coordination with appropriate agencies may be required for excavation and filling in wetlands and transportation of contaminated materials. The possibility exists that a permit may be required for the contaminated soil treatment facility. The permitting requirement rating for Alternative 1-3C is moderate.

Legal Constraints. The ESA may present obstacles to the acceptance of this alternative. Consultation with appropriate agencies during the preparation of project plans and specifications can ensure that concerns are addressed. Contamination of adjacent properties, not under Navy ownership or control, is suspected. The Navy does not have access to remediate this contamination. Therefore, the legal constraint rating for Alternative 1-3C is moderate.

Cultural Resources. No significant cultural resources would be impacted by Alternative 1-3C.

Based on the evaluations presented above, the overall institutional rating for Alternative 1-3C is moderate.

7.3.1.6 Alternative 1-3D

Conformance To ARAR

Executive Order 11,990. Executive Order 11,990 requires that the destruction, loss, or degradation of wetlands be minimized and the natural and beneficial values of wetlands be enhanced in the management of Federal lands. RASS 1 contains a significant amount of brackish water wetlands (115,07 acres). Excavation and filling activities conducted under this alternative will have a significant impact on the wetlands. Proper design and implementation of safeguards during the construction period will limit impacts consistent with the balancing of short term and long term impacts. The extent of excavation has been limited by the selection of an active remediation area that contains only the highest level of contamination and takes into account topographic features of the site. A wetland restoration element has been included in this alternative. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and the migration of such contamination. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. The potential for severe short term impacts was a factor in the development of the site specific cleanup criteria for this alternative. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 1-3D conforms to this ARAR.

Rivers and Harbors Act of 1899. The Rivers and Harbors Act of 1899 regulates the excavation and filling of the navigable waters of the United States. Excavation activities in the wetland areas may fall within the "navigable waters of the United States," regulated under Section 10 of the Rivers and Harbors Act. Alternative 1-3D conforms to this ARAR.

Executive Order 11,988. Executive Order 11,988 requires that the natural and beneficial values of floodplains be restored and preserved in the management of Federal lands. Since RASS 1 contains a significant amount of floodplains, Executive Order 11,988 is an applicable requirement for RASS 1. Excavation and filling activities conducted in the wetlands will be affected by the requirements of Executive Order 11,988 on Floodplain Management. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and the migration of such contamination. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. The potential for severe short term impacts was a factor in the development of the site specific cleanup criteria for this alternative. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 1-3D conforms to this ARAR.

Resource Conservation and Recovery Act (RCRA). The Resource Conservation and Recovery Act regulates the treatment, storage, and disposal of hazardous wastes. Although RASS 1 is not a RCRA site, the requirements of RCRA are relevant and appropriate to the concept of leaving contamination on-site. The RCRA requirements on closure and post-closure care of RCRA facilities in general, and landfills in particular, contain requirements affecting this alternative. These include requirements addressing post-closure care, property use, maintenance of site security, and monitoring (40 CFR 264 Subpart G).

In addition, activities conducted under this alternative including operation of the stabilization/solidification facility and the siting and construction of the monofill will be affected by the requirements of 40 CFR 261, 40 CFR 262, 40 CFR 263, and 40 CFR 264. These requirements can be accommodated during the design process by ensuring that all requirements are addressed in project specifications. Excavation of wetland materials may trigger the RCRA ban on

the landfilling of materials containing free liquids. Alternative 1-3D conforms to this alternative.

Endangered Species Act. The Endangered Species Act prohibits the taking of any endangered species, and requires that actions not be likely to jeopardize the continued existence of any endangered species or result in the destruction or adverse modification of the critical habitat of such species. Because RASS 1 includes significant habitat for endangered species, the Endangered Species Act is an applicable requirement for RASS 1. Excavation of the contaminated materials will result in substantial short term impacts on the habitat and species currently residing on RASS 1. This short term impact will be offset by the long term improvement resulting from the removal of the contamination. The potential for severe short term impacts were a factor in the development of the site specific cleanup criteria for this alternative. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 1-3D conforms to this ARAR.

The Clean Water Act. The Clean Water Act regulates the discharge of pollutants from point sources into the navigable waters of the United States and regulates the discharge of dredged or fill material from point sources into the waters of the United States. Because RASS 1 contains brackish water wetlands and streams, the requirements of the Clean Water Act which regulate the discharge of pollutants into the navigable waters of the United States are relevant and appropriate and the requirements of the Clean Water Act which regulate the discharge of dredged or fill material into the waters of the United States are applicable. Data collected during the RI indicated that there was a discharge of contaminants into the streams and wetlands in the RASS 1 area. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and migration of such contamination. The extent of the reduction in contaminant migration has not been quantified. Construction activities may result in temporary increases in sediment loads to the wetland areas of RASS 1. This possibility can be minimized through adequate design of the selected excavation method. Significant excursions above the Federal Water Quality Criteria during active remediation are not anticipated. Filling, after excavation, will result in substantial short term impacts to the wetlands. The monitoring

program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. Alternative 1-3D partially conforms to this ARAR.

California Water Code. The California Water Code regulates the discharge of contaminants into the waters of the State of California. Because RASS 1 contains brackish water wetlands and streams, the requirements of the California Water Code are relevant and appropriate. Data collected during the RI indicated that there was a discharge of contaminants into the streams and wetlands in the RASS 1 area. This discharge was found to be in excess of the water quality standards. The partial removal of contamination by the remediation involved in this alternative would reduce the contamination on site and the migration of such contamination. The extent of the reduction in contaminant migration has not been quantified. There is the possibility for the short term release of contamination during conduct of the remedial action; however, this potential can be reduced through adequate construction planning. Filling after excavation will result in substantial short term impacts to wetlands. The extensive monitoring program would enable the evaluation of contaminant migration through the surface water pathway and impacts on wetlands. Alternative 1-3D partially conforms to this ARAR.

California Health and Safety Code. The California Health and Safety Code provides guidance on the identification of hazardous materials through the use of the TTLC/STLC criteria. Because the TTLC/STLC criteria provide such guidance, the TTLC/STLC criteria are relevant and appropriate. The State solid waste disposal facility criteria would be applicable to the location, construction, and operation of the facility. Some materials that exceed these criteria would be left in place under this alternative. This alternative will conform to this ARAR in respect to materials disposal. Materials exceeding these criteria that are left on-site will be evaluated through the extensive monitoring program. Alternative 1-3D partially conforms to this ARAR.

The California Fish and Game Code. The California Fish and Game Code prohibits the deposition of substances or materials where such substances or materials can pass into waters of the State of California that would have a detrimental effect on wildlife, and prohibits the taking of any endangered or threatened species of wildlife. Because RASS 1 includes significant habitat

for endangered species, the requirements of the California Fish and Game Code are relevant and appropriate. Data collected in the RI indicated that there was a discharge of such substances or materials into RASS 1. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and the migration of such contamination. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. Alternative 1-3D would conform to this ARAR.

Based on present understanding of the relevant facts, it is anticipated that Alternative 1-3D will be able to attain or partially attain ARAR's. In those cases where partial ARAR's conformance is attained, an environmental impacts waiver has been applied following the balancing of short and long term impacts of remediation with leaving contamination on site. The ARAR conformance rating for Alternative 1-3D is high.

Permitting Requirements. To date, no specific permitting requirements have been identified to date for Alternative 1-3D. However, permits or coordination with appropriate agencies may be required for excavation and filling in wetlands and transportation of contaminated materials. The possibility exists that a permit may be required for the contaminated soil treatment facility and/or the proposed monofill to be constructed on NWS Concord. The permitting requirement rating for Alternative 1-3D is moderate.

Legal Constraints. The ESA may present obstacles to the acceptance of this alternative. Consultation with appropriate agencies during the preparation of project plans and specifications can ensure that concerns are addressed. Contamination of adjacent properties, not under Navy ownership or control, is suspected. The Navy does not have access to remediate this contamination. Therefore, the legal constraint rating for Alternative 1-3D is moderate.

Cultural Resources. No significant cultural resources would be impacted by Alternative 1-3D.

Based on the evaluations presented above, the overall institutional rating for Alternative 1-3D is moderate.

7.3.1.7 Alternative 1-3E

Conformance To ARAR

Executive Order 11,990. Executive Order 11,990 requires that the destruction, loss, or degradation of wetlands be minimized and the natural and beneficial values of wetlands be enhanced in the management of Federal lands. Because RASS 1 contains a significant amount of brackish water wetlands (115.07 acres), Executive Order 11,990 concerning protection of wetlands is an applicable requirement for RASS 1. Excavation activities conducted under this alternative will have a significant impact on the wetlands. Proper design and implementation of safeguards during the construction period will limit impacts consistent with the balancing of short term and long term impacts. The extent of excavation has been limited by the selection of an active remediation area that contains only the highest level of contamination and takes into account topographic features of the site. A wetland restoration element has been included in this alternative. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and the migration of such contamination. The monitoring program would provide detailed information on the environmental effects of the remediation and the contaminants left on site. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 1-3E conforms to this ARAR.

Rivers and Harbors Act of 1899. The Rivers and Harbors Act of 1899 regulates the excavation and filling of the navigable waters of the United States. Excavation activities in the wetland areas may fall within the "navigable waters of the United States," regulated under Section 10 of the Rivers and Harbors Act. Alternative 1-3E conforms to this ARAR.

Executive Order 11,988. Executive Order 11,988 requires that the natural and beneficial values of floodplains be restored and preserved in the management of Federal lands. Since RASS 1 contains a significant amount of floodplains, Executive Order 11,988 is an applicable requirement for RASS 1. Excavation and filling activities conducted in the wetlands will be affected by the requirements of Executive Order 11,988 on Floodplain Management. The partial removal of contamination by the remedial action involved in this alternative

would reduce the amount of contamination on site and the migration of such contamination. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 1-3E conforms to this ARAR.

Resource Conservation and Recovery Act (RCRA). The Resource Conservation and Recovery Act regulates the treatment, storage, and disposal of hazardous wastes. Although RASS 1 is not a RCRA site, the requirements of RCRA are relevant and appropriate to the concept of leaving contamination on-site. The RCRA requirements on closure and post-closure care of RCRA facilities in general, and landfills in particular, contain requirements affecting this alternative. These include requirements addressing post-closure care, property use, maintenance of site security, and monitoring (40 CFR 264 Subpart G).

In addition, activities conducted under this alternative will be affected by the requirements of 40 CFR 261, 40 CFR 262, 40 CFR 263, and 40 CFR 264. These requirements can be accommodated during the design process by ensuring that all requirements are addressed in project specifications. Alternative 1-3E conforms to this ARAR.

Endangered Species Act. The Endangered Species Act prohibits the taking of any endangered species, and requires that actions not be likely to jeopardize the continued existence of any endangered species or result in the destruction or adverse modification of the critical habitat of such species. Because RASS 1 includes significant habitat for endangered species, the Endangered Species Act is an applicable requirement for RASS 1. Excavation of the contaminated materials and filling will result in substantial short term impacts on the habitat and species currently residing on RASS 1. This short term impact will be offset by the long term improvement resulting from the removal of the contamination. The potential for severe short term impacts were a factor in the development of the site specific cleanup criteria for this alternative. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 1-3E conforms to this ARAR.

The Clean Water Act. The Clean Water Act regulates the discharge of pollutants from point sources into the navigable waters of the United States and regulates the discharge of dredged or fill material from point sources in o the waters of the United States. Because RASS 1 contains brackish water wetlands and streams, the requirements of the Clean Water Act that regulate the discharge of pollutants into the navigable waters of the United States are relevant and appropriate and the requirements of the Clean Water Act that regulate the discharge of dredged or fill material into the waters of the United States are applicable. Data collected during the RI indicated that there was a discharge of contaminants into the streams and wetlands in the RASS 1 area. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and migration of such contamination. The extent of the reduction in contaminant migration has not been quantified. Construction activities may result in temporary increases in sediment loads to the wetland areas of RASS 1. This possibility can be minimized through adequate design of the selected excavation method. Significant excursions above the Federal Water Quality Criteria during active remediation are not anticipated. Filling, after excavation, will result in substantial short term impacts to the wetlands. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. Alternative 1-3E partially conforms to this ARAR.

California Water Code. The California Water Code regulates the discharge of hazardous wastes into the waters of the State of California. Because RASS 1 contains brackish water wetlands and streams, the requirements of the California Water Code are relevant and appropriate. Data collected during the RI indicated that there was a discharge of contaminants into the streams and wetlands in the RASS 1 area. This discharge was found to be in excess of the water quality standards. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and migration of such contamination. The extent of the reduction in contaminant migration has not been quantified. There is the possibility for the short term release of contamination during conduct of the remedial action; however, this potential can be reduced through adequate construction planning. Filling, after excavation, will result in substantial short term impacts on the wetlands. The extensive monitoring program would enable the evaluation of

contaminant migration through the surface water pathway. Alternative 1-3E partially conforms to this ARAR.

California Health and Safety Code. The California Health and Safety Code provides guidance on the identification of hazardous materials through the use of the TTLC/STLC criteria. Because the TTLC/STLC criteria provide such guidance, the TTLC/STLC criteria are relevant and appropriate. Materials that exceed these criteria would be disposed of in accordance with appropriate regulations. Some materials that exceed these criteria would be left in place under this alternative. This alternative will conform to this ARAR in respect to materials disposal. Materials exceeding these criteria that are left on-site will be evaluated through the extensive monitoring program. Alternative 1-3E partially conforms to this ARAR.

The California Fish and Game Code. The California Fish and Game Code prohibits the deposition of substances or materials where such substances or materials can pass into waters of the State of California that would have a detrimental effect on wildlife, and prohibits the taking of any endangered or threatened species of wildlife. Because RASS 1 includes significant habitat for endangered species, the requirements of the California Fish and Game Code are relevant and appropriate. Data collected in the RI indicated that there was a discharge of such substances or materials into RASS 1. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 1-3E conforms to this ARAR.

Based on present understanding of the relevant facts, it is anticipated that Alternative 1-3E will be able to attain or partially attain ARAR's. However, because the proposed soil washing process is not a demonstrated technology for metals removal from soils, there is considerable uncertainyy associated with the ability of this alternative to meet ARAR's. Therefore, the ARAR conformance rating for Alternative 1-3E is moderate.

Permitting Requirements. To date, no specific permitting requirements have been identified for Alternative 1-3E. However, permits or coordination with

appropriate agencies may be required for excavation and filling in wetlands and transportation of contaminated materials. The possibility exists that a permit may be required for the contaminated soil treatment facility. Discharges from the contaminated soil treatment facility will probably require a NPDES/SPDES permit for discharge of treated waste waters. The permitting requirement rating for Alternative 1-3E is moderate.

Legal Constraints. The ESA may present obstacles to the acceptance of this alternative. Consultation with appropriate agencies during the preparation of project plans and specifications can ensure that concerns are addressed. Contamination of adjacent properties, not under Navy ownership or control, is suspected. The Navy does not have access to remediate this contamination. Therefore, the legal constraint rating for Alternative 1-3E is moderate.

Cultural Resources. No significant cultural resources would be impacted by Alternative 1-3E.

Based on the evaluations presented above, the overall institutional rating for Alternative 1-3E is low.

7.3.1.7 Alternative 1-3F

Conformance To ARAR

Executive Order 11,990. Executive Order 11,990 requires that the destruction, loss, or degradation of wetlands be minimized and the natural and beneficial values of wetlands be enhanced in the management of Federal lands. Because RASS 1 contains a significant amount of brackish water wetlands (115.07 acres), Executive Order 11,990 concerning protection of wetlands is an applicable requirement for RASS 1. Excavation activities conducted under this alternative will have a significant impact on the wetlands. Proper design and implementation of safeguards during the construction period will limit impacts consistent with the balancing of short term and long term impacts. The extent of excavation has been limited by the selection of an active remediation area that contains only the highest level of contamination and takes into account topographic features of the site. A wetland restoration element has been included in this alternative. The partial removal of contamination by the

remedial action involved in this alternative would reduce the amount of contamination on site and the migration of such contamination. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on site. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 1-3F conforms to this ARAR.

Rivers and Harbors Act of 1899. The Rivers and Harbors Act of 1899 regulates the excavation and filling of the navigable waters of the United States. Excavation activities in the wetland areas may fall within the "navigable waters of the United States," regulated under Section 10 of the Rivers and Harbors Act. Alternative 1-3F conforms to this ARAR.

Executive Order 11,988. Executive Order 11,988 requires that the natural and beneficial values of floodplains be restored and preserved in the management of Federal lands. Since RASS 1 contains a significant amount of floodplains, Executive Order 11,988 is an applicable requirement for RASS 1. Excavation and filling activities conducted in the wetlands will be affected by the requirements of Executive Order 11,988 on Floodplain Management. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and the migration of such contamination. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 1-3F conforms to this ARAR.

Resource Conservation and Recovery Act (RCRA). The Resource Conservation and Recovery Act regulates the treatment, storage, and disposal of hazardous wastes. Although RASS 1 is not a RCRA site, the requirements of RCRA are relevant and appropriate to the concept of leaving contamination on-site. The RCRA requirements on closure and post-closure care of RCRA facilities in general, and landfills in particular, contain requirements affecting this alternative. These include requirements addressing post-closure care, property use, maintenance of site security, and monitoring (40 CFR 264 Subpart G).

In addition, activities conducted under this alternative will be affected by the requirements of 40 CFR 261, 40 CFR 262, 40 CFR 263, and 40 CFR 264. These requirements can be accommodated during the design process by ensuring that all requirements are addressed in project specifications. Alternative 1-3F conforms to this ARAR.

Endangered Species Act. The Endangered Species Act prohibits the taking of any endangered species, and requires that actions not be likely to jeopardize the continued existence of any endangered species or result in the destruction or adverse modification of the critical habitat of such species. Because RASS 1 includes significant habitat for endangered species, the Endangered Species Act is an applicable requirement for RASS 1. Excavation of the contaminated materials and filling will result in substantial short term impacts on the habitat and species currently residing on RASS 1. This short term impact will be offset by the long term improvement resulting from the removal of the contamination. The potential for severe short term impacts were a factor in the development of the site specific cleanup criteria for this alternative. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 1-3F conforms to this ARAR.

Clean Water Act. The Clean Water Act regulates the discharge of pollutants from point sources into the navigable waters of the United States and regulates the discharge of dredged or fill material from point sources into the waters of the United States. Because RASS 1 contains brackish water wetlands and streams, the requirements of the Clean Water Act that regulate the discharge of pollutants into the navigable waters of the United States are relevant and appropriate and the requirements of the Clean Water Act that regulate the discharge of dredged or fill materials into the waters of the United States are applicable. Data collected during the RI indicated that there was a discharge of contaminants into the streams and wetlands in the RASS 1 area. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and migration of such contamination. The extent of the reduction in contaminant migration has not been quantified. Construction activities may result in temporary increases in sediment loads to the wetland areas of RASS 1. This possibility can be minimized through adequate design of the selected excavation method.

Significant excursions above the Federal Water Quality Criteria during active remediation are not anticipated. filling, after excavation, will result in substantial short term impacts to the wetland.s The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. Alternative 1-3F partially conforms to this ARAR.

California Water Code. The California Water Code regulates the discharge of hazardous wastes into the waters of the State of California. Because RASS 1 contains brackish water wetlands and streams, the requirements of the California Water Code are relevant and appropriate. Data collected during the RI indicated that there was a discharge of contaminants into the streams and wetlands in the RASS 1 area. This discharge was found to be in excess of the water qulaity standards. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and migration of such contamination. The extent of the reduction in contaminant migration has not been quantified. There is the possibility for the short term release of contamination during conduct of the remedial action; however, this potential can be reduced through adequate construction planning. Filling, after excavation, will result in substantial short term impacts on the wetlands. The extensive monitoring program would enable the evaluation of contaminant migration through the surface water pathway. Alternative 1-3F partially conforms to this ARAR.

California Health and Safety Code. The California Health and Safety Code provides guidance on the identification of hazardous materials through the use of the TTLC/STLC criteria. Because the TTLC/STLC criteria provide such guidance, the TTLC/STLC criteria are relevant and appropriate. Materials that exceed these criteria would be disposed of in accordance with appropriate regulations. Some materials that exceed these criteria would be left in place under this alternative. This alternative will conform to this ARAR in respect to materials disposal. Materials exceeding these criteria that are left on-site will be evaluated through the extensive monitoring program. Alternative 1-3F partially conforms to this ARAR.

The California Fish and Game Code. The California Fish and Game Code prohibits the deposition of substances or materials where such substances or

materials can pass into waters of the State of California that would have a detrimental effect on wildlife, and prohibits the taking of any endangered or threatened species of wildlife. Because RASS 1 includes significant habi at for endangered species, the requirements of the California Fish and Game Code are relevant and appropriate. Data collected in the RI indicated that there was a discharge of such substances or materials into RASS 1. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 1-3F conform to this ARAR.

Based on present understanding of the relevant facts, it is anticipated that Alternative 1-3F will be able to attain or partially attain ARAR's. However, because the proposed soil washing process is not a demonstrated technology for metals removal from soils, there is considerable uncertainty associated with the ability of this alternative to meet ARAR's. Therefore, the ARAR conformance rating of Alternative 1-3F is moderate.

Permitting Requirements. To date, no specific permitting requirements have been identified for Alternative 1-3F. However, permits or coordination with appropriate agencies may be required for excavation and filling in wetlands and transportation of contaminated materials. The possibility exists that a permit may be required for the contaminated soil treatment facility. Discharges from the contaminated soil treatment facility will probably require a NPDES/SPDES permit for discharge of treated waste waters. The permitting requirement rating for Alternative 1-3F is moderate.

Legal Constraints. The ESA may present obstacles to the acceptance of this alternative. Consultation with appropriate agencies during the preparation of project plans and specifications can ensure that concerns are addressed. Contamination of adjacent properties, not under Navy ownership or control is suspected. The Navy does not have access to remediate this contamination. Therefore, the legal constraint rating for Alternative 1-3F is moderate.

Cultural Resources. No significant cultural resources would be impacted by this alternative.

Based on the evaluations presented above, the overall institutional rating for Alternative 1-3F is low.

The institutional requirements evaluation for RASS 1 is summarized in Table 7.15.

7.3.2 Remedial Action Subsite 2

7.3.2.1 Alternative 2-1

ARAR's identified for RASS 2 are summarized in Table 7.16

Conformance To ARAR

Executive Order 11,990. Executive Order 11,990 requires that the destruction, loss, or degradation of wetlands be minimized and the natural and beneficial values of wetlands be enhanced in the management of Federal lands. Since RASS 2 contains a significant amount of brackish water wetlands (4.11 acres), Executive Order 11,990 concerning protection of wetlands is an applicable requirement for RASS 2. The no action alternative leaves significant levels of contamination on RASS 2 and is expected to continue to have adverse impacts on the animal and vegetative populations on the RASS. Alternative 2-1 does not conform to this ARAR.

Resource Conservation and Recovery Act (RCRA). The Resource Conservation and Recovery Act regulates the treatment, storage, and disposal of hazardous wastes. Although RASS 2 is not a RCRA site, the requirements of RCRA are relevant and appropriate to the concept of leaving contamination on-site. The RCRA requirements on closure and post-closure care of RCRA facilities in general, and landfills in particular, contain requirements affecting this alternative. These include requirements addressing post-closure care, property use, maintenance of site security, and monitoring (40 CFR 264 Subpart G). Alternative 2-1 does not conform to this ARAR.

Endangered Species Act. The Endangered Species Act prohibits the taking of any endangered species, and requires that actions not be likely to jeopardize the continued existence of any endangered species or result in the destruction

Table 7.15

Institutional Requirements Evaluation of Remedial Alternatives for RASS 1

Remedial Alternatives		Evaluation Criteria				
		Conformance to ARAR	Permitting Requirements	Legal Constraints	Impact on Historic and Cultural Resources	Overall Rating
Alternative 1-1:	No Action	Low	High	Low	None	Low
Alternative 1-2:	Environmental Monitoring	Low	High	Low	None	Low
Alternative 1-3A:	Excavation/Disposal At Existing Landfills/ Restoration	High	High	Moderate	None	High
Alternative 1-3C:	Excavation/ Immobilization/ Disposal At Existing Landfills/ Restoration	High	Moderate	Moderate	None	Moderate
Alternative 1-3D:	Excavation/ Immobilization/ Disposal At Monofill on NWS Concord/ Restoration	High	Moderate	Moderate	None	Moderate
Alternative 1-3E:	Excavation/Soil Washing/Disposal At Existing Landfill/ Restoration	Moderate	Low	Moderate	None	Low
Alternative 1-3F:	Excavation/Soil Washing/Disposal At Monofill on NWS Concord/Restoration	Moderate	Low	Moderate	None	Low

Table 7.16

Summary of ARAR Analysis for RASS 2

	FCWA* (404)	FCWA* (402)	SWDA*	ESA* (7)	ESA* (9)	SDWA*	RHA*	E.O.* 11,990	E.O.* 11,988	CHSC*	CWC*	CFGC*	CPRC*
Locational													
Upland													
Waters											A	R	
Stream											R		
Wetlands	R							A	A		R		
Adjacent to Bay	R							A	A		R		
Adjacent to Stream	R							A	A		R		
Endangered Species													
Habitat				A	A							A	
Other Habitat													
Chemicals													
Arsenic		R	R			R				R	R	R	
Cadmium		R	R			R				R	R	R	
Copper		R	R			R				R	R	R	
Lead		R	R			R				R	R	R	
Selenium		R	R			R				R	R	R	
Zinc		R	R			R				R	R	R	
Remedial Action													
Excavation of Soil													
From Upland													
From Wetland													
From Endangered Species								A	A			A	
Habitat				A	A								
From Other Habitat													
Removal of Soil								A	A				A
Off-site Transport of Soil													
Off-site Disposal of Soil			A							A			
Backfilling in Wetlands	A							A	A		A	R	A
Backfilling in Uplands									A				

* FCWA = Federal Clean Water Act
SWDA = Solid Waste Disposal Act
ESA = Endangered Species Act
SDWA = Safe Drinking Water Act
RHA = Rivers & Harbors Act

E.O. = Executive Order
CHSC = California Health & Safety Code
CWC = California Water Code
CFGC = California Fish & Game Code
CPRC = California Public Resources Code

A = Applicable
R = Relevant or Appropriate
() = Operative Section

or adverse modification of the critical habitat of such species. Because RASS 2 includes significant habitat for endangered species, the Endangered Species Act is an applicable requirement for RASS 2. Failure to remove known high levels of contamination would have an adverse impact on these species. Alternative 2-1 does not conform to this ARAR.

The Clean Water Act. The Clean Water Act regulates the discharge of pollutants from point sources into the navigable waters of the United States. Because RASS 2 contains brackish water wetlands and streams, the requirements of the Clean Water Act are relevant and appropriate. Data collected during the RI documented the migration of contamination through the surface water pathway. Concentrations of metals in excess of ambient water quality standards were documented. Leaving the contaminants in-place will result in the continued migration of metals into the surface water. Alternative 2-1 does not conform to this ARAR.

California Water Code. The California Water Code regulates the discharge of hazardous wastes into the waters of the State. Because RASS 2 contains brackish water wetlands, the requirements of the California Water Code are relevant and appropriate. Data collected during the RI indicated that there was a discharge of hazardous waste into wetlands in the RASS 2 area. This discharge was found to be in excess of the water quality standards. Alternative 2-1 does not conform to this ARAR.

California Health and Safety Code. The California Health and Safety Code provides guidance on the identification of hazardous materials through the use of the TTLC/STLC criteria. Because the TTLC/STLC criteria provide such guidance, the TTLC/STLC criteria are relevant and appropriate. Materials exceeding these criteria have been identified on RASS 2 and would be left in place under this alternative. Alternative 2-1 does not conform to this ARAR.

The California Fish and Game Code. The California Fish and Game Code prohibits the deposition of substances or materials where such substances or materials can pass into waters of the State of California that would have a detrimental effect on wildlife, and prohibits the taking of any endangered or threatened species of wildlife. Because RASS 2 includes significant habitat for endangered species, the requirements of the California Fish and Game Code

are relevant and appropriate. Data collected in the RI indicated that there was a discharge of such substances or materials into RASS 2. Alternative 2-1 does not conform to this ARAR.

Based on present understanding of the relevant facts, it is anticipated that Alternative 2-1 will be unable to attain ARAR's primarily because of the substantial quantities of contaminated materials left on RASS 2. The ARAR conformance rating for Alternative 2-1 is low.

Permitting Requirements. No permitting requirements have been identified to date for Alternative 2-1. Since no permitting requirements have been identified, the permit requirement rating of Alternative 2-1 is high.

Legal Constraints. Because contamination is left in-place, the ESA may present obstacles to the acceptance of this alternative. Therefore, the legal constraint rating for Alternative 2-1 rating is low.

Cultural Resources. No significant cultural resources would be impacted by Alternative 2-1.

Based on the evaluations presented above, the overall institutional rating for Alternative 2-1 is low.

7.3.2.2 Alternative 2-2

Conformance To ARAR

Executive Order 11,990. Executive Order 11,990 requires that the destruction, loss, or degradation of wetlands be minimized and the natural and beneficial values of wetlands be enhanced in the management of Federal lands. Since RASS 1 contains a significant amount of brackish water wetlands (4.11 acres), Executive Order 11,990 concerning protection of wetlands is an applicable requirement for RASS 2. The environmental monitoring alternative leaves significant levels of contamination on RASS 2 and is expected to continue to have adverse impacts on the animal and vegetative populations on the RASS. Implementation of an extensive environmental monitoring program will aid in the identification and evaluation of adverse impacts; however, such a monitoring

program will not remove existing contamination nor prevent the continued migration of contamination. Alternative 2-2 does not conform to this ARAR.

Resource Conservation and Recovery Act (RCRA). The Resource Conservation and Recovery Act regulates the treatment, storage, and disposal of hazardous wastes. Although RASS 2 is not a RCRA site per se, RCRA requirements on closure and post-closure care of RCRA facilities in general, and landfills in particular, contain requirements that are relevant and appropriate to this alternative. These include requirements addressing post-closure care, property use, maintenance of site security, and monitoring (40 CFR 264 Subpart G). Although this alternative may be designed to meet most of these concerns, the fact that significant levels of contamination will be allowed to remain on-site may raise significant RCRA concerns. Alternative 2-2 would only partially conform to this ARAR.

Endangered Species Act. The Endangered Species Act prohibits the taking of any endangered species, and requires that actions not be likely to jeopardize the continued existence of any endangered species or result in the destruction or adverse modification of the critical habitat of such species. Because RASS 1 includes significant habitat for endangered species, the Endangered Species Act is an applicable requirement for RASS 2. Failure to remove known high levels of contamination would have an adverse impact on these species. Although the environmental monitoring alternative will document these impacts, the impacts will continue to occur. Alternative 2-2 will only partially conform to this ARAR.

The Clean Water Act. The Clean Water Act regulates the discharge of pollutants from point sources into the navigable waters of the United States. Because RASS 2 contains brackish water wetlands, the requirements of the Clean Water Act are relevant and appropriate. Data collected during the RI documented the migration of contamination through the surface water pathway. Concentrations of metals in excess of ambient water quality standards were documented. Leaving the contaminants in-place will result in the continued migration of metals into the surface water. Monitoring will provide information on the migration of contaminants; however, monitoring will not prevent the continued migration of contamination. Alternative 2-2 does not conform to this ARAR.

California Water Code. The California Water Code regulates the discharge of hazardous waste into the waters of the State of California. Because RASS 2 contains brackish water wetlands and streams, the requirements of the California water Code are relevant and appropriate. Data collected during the RI indicated that there was a discharge of hazardous substances into the streams and wetlands in the RASS 2 area. This discharge was found to be in excess of the water quality standards. An extensive monitoring program would enable the evaluation of contaminant migration through the surface water pathway; however, it would not prevent such migration. Alternative 2-2 does not conform to this ARAR.

California Health and Safety Code. The California Health and Safety Code provides guidance on the identification of hazardous materials through the use of the TTLC/STLC criteria. Because the TTLC/STLC criteria provide such guidance, the TTLC/STLC criteria are relevant and appropriate. Materials exceeding these criteria have been identified on RASS 2 and would be left in place under this alternative. Alternative 2-2 may not conform to this ARAR.

The California Fish and Game Code. The California Fish and Game Code prohibits the deposition of substances or materials where such substances or materials can pass into waters of the State of California that would have a detrimental effect on wildlife, and prohibits the taking of any endangered or threatened species of wildlife. Because RASS 2 includes significant habitat for endangered species, the requirements of the California Fish and Game Code are relevant and appropriate. Data collected in the RI indicated that there was a discharge of such substances or materials into RASS 2. The monitoring program would provide detailed information on the environmental effects of the hazardous substances that have been discharged onto RASS 2, however, would not prevent continuation of the impacts. Alternative 2-2 would not conform to this ARAR.

Based on present understanding of the relevant facts, it is anticipated that Alternative 2-2 will be unable to attain ARAR's primarily because of the substantial quantities of contaminated materials left on RASS 2. The ARAR conformance rating of Alternative 2-2 is low.

Permitting Requirements. No permitting requirements have been identified to date for Alternative 2-2. Since no permitting requirements have been identified, the permitting requirement rating for Alternative 2-2 is high.

Legal Constraints. The ESA may present obstacles to the acceptance of this alternative. In addition, there is suspected contamination along the boundary of RASS 2 on property that is not owned by the Navy. This property will need to be included in the monitoring program; however, the Navy does not have access to the property. Therefore, the legal constraint rating for Alternative 2-2 is low.

Cultural Resources. No significant cultural resources would be impacted by Alternative 2-2.

Based on the evaluations presented above, the overall institutional rating for Alternative 2-2 is low.

7.3.2.3 Alternative 2-3A

Conformance To ARAR

Executive Order 11,990. Executive Order 11,990 requires that the destruction, loss, or degradation of wetlands be minimized and the natural and beneficial values of wetlands be enhanced in the management of Federal lands. Since RASS 1 contains a significant amount of brackish water wetlands (4.11 acres), Executive Order 11,990 concerning protection of wetlands is an applicable requirement for RASS 2. Excavation and filling activities conducted under this alternative will have a significant impact on the wetlands. Proper design and implementation of safeguards during the construction period will limit impacts consistent with the balancing of short term and long term impacts. The extent of excavation has been limited by the selection of an active remediation area that contains the highest levels of contamination and takes into account topographic features of the site. A wetland restoration element has been included in this alternative. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and the migration of such contamination. The

monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. The potential for severe short term impacts was a factor in the development of the site specific cleanup criteria for this alternative. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 2-3A conforms to this ARAR.

Rivers and Harbors Act of 1899. The Rivers and Harbors Act of 1899 regulates the excavation and filling of the navigable waters of the United States. Excavation activities areas may fall within the "navigable waters of the United States," regulated under Section 10 of the Rivers and Harbors Act. Balancing of short term and long term impacts is consistent with this ARAR. Alternative 2-3A conforms to this ARAR.

Executive Order 11,988. Executive Order 11,988 requires that the natural and beneficial values of floodplains be restored and preserved in the management of Federal lands. Since RASS 2 contains a significant amount of floodplains, Executive Order 11,988 is an applicable requirement for RASS 2. Excavation and filling activities conducted in the wetlands will be affected by the requirements of Executive Order 11,988 on Floodplain Management. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and the migration of such contamination. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. The potential for severe short term impacts was a factor in the development of the site specific cleanup criteria for this alternative. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 2-3A conforms to this ARAR.

Resource Conservation and Recovery Act (RCRA). The Resource Conservation and Recovery Act regulates the treatment, storage, and disposal of hazardous wastes. Although RASS 2 is not a RCRA site, the requirements of RCRA are relevant and appropriate to the concept of leaving contamination on-site. The RCRA requirements on closure and post-closure care of RCRA facilities in general, and landfills in particular, contain requirements affecting this alternative. These include requirements addressing post-closure care, property

use, maintenance of site security, and monitoring (40 CFR 264 Subpart G). Activities conducted under this alternative will be affected by the requirements of 40 CFR 261, 40 CFR 262, and 40 CFR 263. These requirements can e accommodated during the design process by ensuring that all requirements are addressed in project specifications.

Excavation and off-site transportation of contaminated materials will trigger the requirement to meet applicable Department of Transportation regulations. The transport of contaminated materials can be accomplished in accordance with such regulations. Excavation of wetland materials may trigger the RCRA ban on the landfilling of materials containing free liquids. Alternative 2-3A conforms to this ARAR.

Endangered Species Act. The Endangered Species Act prohibits the taking of any endangered species, and requires that actions not be likely to jeopardize the continued existence of any endangered species or result in the destruction or adverse modification of the critical habitat of such species. Because RASS 1 includes significant habitat for endangered species, the Endangered Species Act is an applicable requirement for RASS 2. Excavation of the contaminated materials and filling will result in substantial short term impacts on the habitat and species currently residing on RASS 2. This short term impact will be offset by the long term improvement resulting from the removal of the contamination. The potential for severe short term impacts was a factor in the development of the site specific cleanup criteria for this alternative. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 2-3A conforms to this ARAR.

The Clean Water Act. The Clean Water Act regulates the discharge of pollutants from point sources into the navigable waters of the United States and regulates the discharge of dredged or fill material from point sources into the waters of the United States. Because RASS 2 contains brackish water wetlands and streams, the requirements of the Clean Water Act which regulate the discharge of pollutants into the navigable waters of the United States are relevant and appropriate and the requirements of the Clean Water Act which regulate the discharge of dredged or fill material into the waters of the

United States are applicable. Data collected during the RI indicated that there was a discharge of contaminants into the streams and wetlands in the RASS 2 area. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and migration of such contamination. The extent of the reduction has not been quantified. Construction activities may result in temporary increases in sediment and contaminant loads to the wetland areas of RASS 2. This possibility can be minimized through adequate design of the selected excavation method. Significant excursions above the Federal Ambient Water Quality Criteria during active remediation are not anticipated. Filling, after excavation, will result in substantial short term impacts to the wetlands. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. Alternative 2-3A partially conforms to this ARAR.

California Water Code. The California Water Code regulates the discharge of hazardous wastes into the waters of the State of California. Because RASS 2 contains brackish water wetlands and streams, the requirements of the California Water Code are relevant and appropriate. Data collected during the RI indicated that there was a discharge of contaminants into the streams and wetlands in the RASS 2 area. This discharge was found to be in excess of the water quality standards. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and migration of such contamination. The extent of the reduction has not been quantified. There is the possibility for the short term release of contamination during conduct of the remedial action; however, this potential can be minimized through adequate construction planning. Filling, after excavation, will result in substantial short term impacts to the wetlands. The extensive monitoring program would enable the evaluation of contaminant migration through the surface water pathway and impacts on the wetlands. Alternative 2-3A partially conforms to this ARAR.

California Health and Safety Code. The California Health and Safety Code provides guidance on the identification of hazardous materials through the use of the TTLC/STLC criteria. Because the TTLC/STLC criteria provide such guidance, the TTLC/STLC criteria are relevant and appropriate. Materials that exceed

these criteria would be disposed of in accordance with appropriate regulations. All materials that exceed these criteria would be removed under this alternative. This alternative will conform to this ARAR in respect to materials disposal. Although significant quantities of contaminants are removed by this alternative, some contaminated materials would be left on site. Such materials that are left on site will be evaluated through the extensive monitoring program. Alternative 2-3A partially conforms to this ARAR.

The California Fish and Game Code. The California Fish and Game Code prohibits the deposition of substances or materials where such substances or materials can pass into waters of the State of California that would have a detrimental effect on wildlife, and prohibits the taking of any endangered or threatened species of wildlife. Because RASS 2 includes significant habitat for endangered species, the requirements of the California Fish and Game Code are relevant and appropriate. Data collected in the RI indicated that there was a discharge of such substances or materials into RASS 2. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and the migration of such contamination. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. Alternative 2-3A would conform to this ARAR.

Based on present understanding of the relevant facts, it is anticipated that Alternative 2-3A will be able to attain or partially attain ARAR's. In those cases where partial ARAR's conformance is attained, an environmental impacts waiver has been applied following the balancing of short and long term impacts of remediation with leaving contamination on site. The ARAR conformance rating for Alternative 2-3A is high.

Permitting Requirements. No specific permitting requirements have been identified to date for Alternative 2-3A. However, permits or coordination with appropriate agencies may be required for excavation and filling in wetlands and transportation of contaminated materials. The permitting requirement rating for Alternative 2-3A is high.

Legal Constraints. The ESA may present obstacles to the acceptance of this alternative. Consultation with appropriate agencies during the preparation of project plans and specifications can ensure that concerns are addressed. Contamination of adjacent properties, not under Navy ownership or control, is suspected. The Navy does not have access to remediate this contamination. Therefore, the legal constraint rating for Alternative 2-3A is moderate.

Cultural Resources. No significant cultural resources would be impacted by Alternative 2-3A.

Based on the evaluations presented above, the overall institutional rating for Alternative 2-1 is high.

7.3.2.4 Alternative 2-3C

Conformance To ARAR

Executive Order 11,990. Executive Order 11,990 requires that the destruction, loss, or degradation of wetlands be minimized and the natural and beneficial values of wetlands be enhanced in the management of Federal lands. Since RASS 1 contains a significant amount of brackish water wetlands (4.11 acres), Executive Order 11,990 concerning protection of wetlands is an applicable requirement for RASS 2. Excavation and filling activities conducted under this alternative will have a significant impact on the wetlands. Proper design and implementation of safeguards during the construction period will limit impacts consistent with the balancing of short term and long term impacts. The extent of excavation has been limited by the selection of an active remediation area that contains the highest level of contamination and takes into account topographic features of the site. A wetland restoration element has been included in this alternative. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and the migration of such contamination. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site.

The potential for severe short term impacts was a factor in the development of the site specific cleanup criteria for this alternative. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 2-3C conforms to this ARAR.

Rivers and Harbors Act of 1899. The Rivers and Harbors Act of 1899 regulates the excavation and filling of the navigable waters of the United States. Excavation activities in the wetland areas may fall within the "navigable waters of the United States," regulated under Section 10 of the Rivers and Harbors Act. Alternative 2-3C conforms to this ARAR.

Executive Order 11,988. Executive Order 11,988 requires that the natural and beneficial values of floodplains be restored and preserved in the management of Federal lands. Since RASS 2 contains a significant amount of floodplains, Executive Order 11,988 is an applicable requirement for RASS 2. Excavation and filling activities conducted in the wetlands will be affected by the requirements of Executive Order 11,988 on Floodplain Management. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and the migration of such contamination. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. The potential for severe short term impacts was a factor in the development of the site specific cleanup criteria for this alternative. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 2-3C would conform to this ARAR.

Resource Conservation and Recovery Act (RCRA). The Resource Conservation and Recovery Act regulates the treatment, storage, and disposal of hazardous wastes. Although RASS 2 is not a RCRA site, the requirements of RCRA are relevant and appropriate to the concept of leaving contamination on-site. The RCRA requirements on closure and post-closure care of RCRA facilities in general, and landfills in particular, contain requirements affecting this alternative. These include requirements addressing post-closure care, property use, maintenance of site security, and monitoring (40 CFR 264 Subpart G).

The purpose of the on-site stabilization/solidification plant is to immobilize certain metals in the contaminated soils and sediments. Therefore, the regulations governing owners and operators of hazardous waste treatment facilities would be relevant and appropriate. Activities conducted under this alternative will be affected by the requirements of 40 CFR 261, 40 CFR 262, 40 CFR 263, and 40 CFR 264. These requirements can be accommodated during the design process by ensuring that all requirements are addressed in project specifications.

Excavation of wetland materials may trigger the ban on the landfilling of materials containing free liquids. The proposed stabilization/solidification process should eliminate this possibility. Alternative 2-3C would conform to this ARAR.

Endangered Species Act. The Endangered Species Act prohibits the taking of any endangered species, and requires that actions not be likely to jeopardize the continued existence of any endangered species or result in the destruction or adverse modification of the critical habitat of such species. Because RASS 1 includes significant habitat for endangered species, the Endangered Species is an applicable requirement for RASS 2. Excavation of the contaminated materials will result in substantial short term impacts on the habitat and species currently residing on RASS 2. This short term impact will be offset by the long term improvement resulting from the removal of the contamination. The potential for severe short term impacts was a factor in the development of the site specific cleanup criteria for this alternative. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 2-3C conforms to this ARAR.

The Clean Water Act. The Clean Water Act regulates the discharge of pollutants from point sources into the navigable waters of the United States and regulates the discharge of dredged or fill material from point sources into the waters of the United States. Because RASS 2 contains brackish water wetlands and streams, the requirements of the Clean Water Act which regulate the discharge of pollutants into the navigable waters of the United States are relevant and appropriate and the requirements of the Clean Water Act which

regulate the discharge of dredged or fill material into the waters of the United States are applicable. Data collected during the RI indicated that there was a discharge of contaminants into the streams and wetlands in the RASS 2 area. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and migration of such contamination. The extent of the reduction in contaminant migration has not been quantified. Construction activities may result in temporary increases in sediment loads to the wetland areas of RASS 2. This possibility can be minimized through adequate design of the selected excavation method. Significant excursions above the Federal Water Quality Criteria during active remediation are not anticipated. Filling, after excavation, will result in substantial short term impacts to the wetlands. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. Alternative 2-3C partially conforms to this ARAR.

California Water Code. The California Water Code regulates the discharge of hazardous wastes into the waters of the State of California. Because RASS 2 contains brackish water wetlands and streams, the requirements of the California Water Code are relevant and appropriate. Data collected during the RI indicated that there was a discharge of contaminants into the streams and wetlands in the RASS 2 area. This discharge was found to be in excess of the water quality standards. The partial removal of contamination proposed by the remedial action involved in this alternative would reduce the amount of contamination on site and migration of such contamination. The extent of the reduction in contaminant migration has not been quantified. There is the possibility for the short term release of contamination during conduct of the remedial action; however, this potential can be reduced through adequate construction planning. Filling, after excavation, will result in substantial short term impacts to wetlands. The extensive monitoring program would enable the evaluation of contaminant migration through the surface water pathway and impacts on the wetlands. Alternative 2-3C partially conforms to this ARAR.

California Health and Safety Code. The California Health and Safety Code provides guidance on the identification of hazardous materials through the use of the TTLC/STLC criteria. Because the TTLC/STLC criteria provide such guidance, the TTLC/STLC criteria are relevant and appropriate. All materials that

exceed these criteria will be removed from RASS 2. Materials that exceed these criteria would be disposed of in accordance with appropriate regulations. The California Health and Safety Code also affects the treatment and disposal of materials excavated from the RASS. This alternative will conform to this ARAR in respect to materials disposal. Contaminated materials that are left on-site will be evaluated through the extensive monitoring program. Alternative 2-3C partially conforms to this ARAR.

The California Fish and Game Code. The California Fish and Game Code prohibits the deposition of substances or materials where such substances or materials can pass into waters of the State of California that would have a detrimental effect on wildlife, and prohibits the taking of any endangered or threatened species of wildlife. Because RASS 2 includes significant habitat for endangered species, the requirements of the California Fish and Game Code are relevant and appropriate. Data collected in the RI indicated that there was a discharge of such substances or materials into RASS 2. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and the migration of such contamination. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. Although some contamination will be left on-site, Alternative 2-3C would conform to this ARAR.

Based on present understanding of the relevant facts, it is anticipated that Alternative 2-3C will be able to attain or partially attain ARAR's. In those cases where partial ARAR's conformance is attained, an environmental impacts waiver has been applied following the balancing of short and long term impacts of remediation with leaving contamination on site. The ARAR conformance rating of Alternative 2-3C is high.

Permitting Requirements. To date, no specific permitting requirements have been identified to date for Alternative 2-3C. However, permits or coordination with appropriate agencies may be required for excavation and filling in wetlands and transportation of contaminated materials. The possibility exists the a permit may be required for the contaminated soil treatment facility. The permitting requirement rating for Alternative 2-3C is moderate.

Legal Constraints. The ESA may present obstacles to the acceptance of this alternative. Consultation with appropriate agencies during the preparation of project plans and specifications can ensure that concerns are addressed. Contamination of adjacent properties, not under Navy ownership or control, is suspected. The Navy does not have access to remediate this contamination. Therefore, the legal constraint rating for Alternative 2-3C is moderate.

Cultural Resources. No significant cultural resources would be impacted by Alternative 2-3C.

Based on the evaluations presented above, the overall institutional rating for Alternative 2-3C is moderate.

7.3.2.6 Alternative 2-3D

Conformance To ARAR

Executive Order 11,990. Executive Order 11,990 requires that the destruction, loss, or degradation of wetlands be minimized and the natural and beneficial values of wetlands be enhanced in the management of Federal lands. RASS 2 contains a significant amount of brackish water wetlands (4.11 acres). Excavation and filling activities conducted under this alternative will have a significant impact on the wetlands. Proper design and implementation of safeguards during the construction period will limit impacts consistent with the balancing of short term and long term impacts. The extent of excavation has been limited by the selection of an active remediation area that contains the highest level of contamination and takes into account topographic features of the site. A wetland restoration element has been included in this alternative. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and the migration of such contamination. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. The potential for severe short term impacts was a factor in the development of the site specific cleanup criteria for this alternative. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 2-3D conforms to this ARAR.

Rivers and Harbors Act of 1899. The Rivers and Harbors Act of 1899 regulates the excavation and filling of the navigable waters of the United States. Excavation activities in the wetland areas may fall within the "navigable waters of the United States," regulated under Section 10 of the Rivers and Harbors Act. Alternative 2-3D conforms to this ARAR.

Executive Order 11,988. Executive Order 11,988 requires that the natural and beneficial values of floodplains be restored and preserved in the management of Federal lands. Since RASS 2 contains a significant amount of floodplains, Executive Order 11,988 is an applicable requirement for RASS 2. Excavation and filling activities conducted in the wetlands will be affected by the requirements of Executive Order 11,988 on Floodplain Management. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and the migration of such contamination. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. The potential for severe short term impacts was a factor in the development of the site specific cleanup criteria for this alternative. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 2-3D conforms to this ARAR.

Resource Conservation and Recovery Act (RCRA). The Resource Conservation and Recovery Act regulates the treatment, storage, and disposal of hazardous wastes. Although RASS 2 is not a RCRA site, the requirements of RCRA are relevant and appropriate to the concept of leaving contamination on-site. The RCRA requirements on closure and post-closure care of RCRA facilities in general, and landfills in particular, contain requirements affecting this alternative. These include requirements addressing post-closure care, property use, maintenance of site security, and monitoring (40 CFR 264 Subpart G).

In addition, activities conducted under this alternative including operation of the stabilization/solidification facility and the siting and construction of the monofill will be affected by the requirements of 40 CFR 261, 40 CFR 262, 40 CFR 263, and 40 CFR 264. These requirements can be accommodated during the design process by ensuring that all requirements are addressed in project

specifications. Excavation of wetland materials may trigger the RCRA ban on the landfilling of materials containing free liquids. Alternative 2-3D conforms to this alternative.

Endangered Species Act. The Endangered Species Act prohibits the taking of any endangered species, and requires that actions not be likely to jeopardize the continued existence of any endangered species or result in the destruction or adverse modification of the critical habitat of such species. Because RASS 1 includes significant habitat for endangered species, the Endangered Species Act is an applicable requirement for RASS 2. Excavation of the contaminated materials will result in substantial short term impacts on the habitat and species currently residing on RASS 2. This short term impact will be offset by the long term improvement resulting from the removal of the contamination. The potential for severe short term impacts was a factor in the development of the site specific cleanup criteria for this alternative. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 2-3D conforms to this ARAR.

The Clean Water Act. The Clean Water Act regulates the discharge of pollutants from point sources into the navigable waters of the United States and regulates the discharge of dredged or fill material from point sources into the waters of the United States. Because RASS 2 contains brackish water wetlands and streams, the requirements of the Clean Water Act which regulate the discharge of pollutants into the navigable waters of the United States are relevant and appropriate and the requirements of the Clean Water Act which regulate the discharge of dredged or fill material into the waters of the United States are applicable. Data collected during the RI indicated that there was a discharge of contaminants into the streams and wetlands in the RASS 2 area. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and migration of such contamination. The extent of the reduction in contaminant migration has not been quantified. Construction activities may result in temporary increases in sediment loads to the wetland areas of RASS 2. This possibility can be minimized through adequate design of the selected excavation method. Significant excursions above the Federal Water Quality Criteria during active remediation are not anticipated. Filling, after excavation,

will result in substantial short term impacts to the wetlands. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. Alternative 2-3D partially conforms to this ARAR.

California Water Code. The California Water Code regulates the discharge of contaminants into the waters of the State of California. Because RASS 2 contains brackish water wetlands and streams, the requirements of the California Water Code are relevant and appropriate. Data collected during the RI indicated that there was a discharge of contaminants into the streams and wetlands in the RASS 2 area. This discharge was found to be in excess of the water quality standards. The partial removal of contamination by the remediation involved in this alternative would reduce the contamination on site and the migration of such contamination. The extent of the reduction in contamination migration has not been quantified. There is the possibility for the short term release of contamination during conduct of the remedial action; however, this potential can be reduced through adequate construction planning. Filling after excavation will result in substantial short term impacts to wetlands. The extensive monitoring program would enable the evaluation of contaminant migration through the surface water pathway and impacts on wetlands. Alternative 2-3D partially conforms to this ARAR.

California Health and Safety Code. The California Health and Safety Code provides guidance on the identification of hazardous materials through the use of the TTLC/STLC criteria. Because the TTLC/STLC criteria provide such guidance, the TTLC/STLC criteria are relevant and appropriate. The State solid waste disposal facility criteria would be applicable to the location, construction, and operation of the facility. All materials that exceed these criteria would be removed from the RASS. This alternative will conform to this ARAR in respect to materials disposal. Contaminated materials that are left on-site will be evaluated through the extensive monitoring program. Alternative 2-3D partially conforms to this ARAR.

The California Fish and Game Code. The California Fish and Game Code prohibits the deposition of substances or materials where such substances or materials can pass into waters of the State of California that would have a

detrimental effect on wildlife, and prohibits the taking of any endangered or threatened species of wildlife. Because RASS 2 includes significant habitat for endangered species, the requirements of the California Fish and Game Code are relevant and appropriate. Data collected in the RI indicated that there was a discharge of such substances or materials into RASS 2. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and the migration of such contamination. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. Alternative 2-3D would conform to this ARAR.

Based on present understanding of the relevant facts, it is anticipated that Alternative 2-3D will be able to attain or partially attain ARAR's. In those cases where partial ARAR's conformance is attained, an environmental impacts waiver has been applied following the balancing of short and long term impacts of remediation with leaving contamination on site. The ARAR conformance rating for Alternative 2-3D is high.

Permitting Requirements. To date, no specific permitting requirements have been identified to date for Alternative 2-3D. However, permits or coordination with appropriate agencies may be required for excavation and filling in wetlands and transportation of contaminated materials. The possibility exists that a permit may be required for the contaminated soil treatment facility and/or the proposed monofill to be constructed on NWS Concord. The permitting requirement rating for Alternative 2-3D is moderate.

Legal Constraints. The ESA may present obstacles to the acceptance of this alternative. Consultation with appropriate agencies during the preparation of project plans and specifications can ensure that concerns are addressed. Contamination of adjacent properties, not under Navy ownership or control is suspected. The Navy does not have access to remediate this contamination. Therefore, the legal constraint rating for Alternative 2-3D is moderate.

Cultural Resources. No significant cultural resources would be impacted by Alternative 2-3D.

Based on the evaluations presented above, the overall institutional rating for Alternative 2-3D is moderate.

7.3.2.7 Alternative 2-3E

Conformance To ARAR

Executive Order 11,990. Executive Order 11,990 requires that the destruction, loss, or degradation of wetlands be minimized and the natural and beneficial values of wetlands be enhanced in the management of Federal lands. Because RASS 2 contains a significant amount of brackish water wetlands (4.11 acres), Executive Order 11,990 concerning protection of wetlands is an applicable requirement for RASS 2. Excavation activities conducted under this alternative will have a significant impact on the wetlands. Proper design and implementation of safeguards during the construction period will limit impacts consistent with the balancing of short term and long term impacts. The extent of excavation has been limited by the selection of an active remediation area that contains the highest level of contamination and takes into account topographic features of the site. A wetland restoration element has been included in this alternative. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and the migration of such contamination. The monitoring program would provide detailed information on the environmental effects of the remediation and the contaminants left on site. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 2-3E conforms to this ARAR.

Rivers and Harbors Act of 1899. The Rivers and Harbors Act of 1899 regulates the excavation and filling of the navigable waters of the United States. Excavation activities in the wetland areas may fall within the "navigable waters of the United States," regulated under Section 10 of the Rivers and Harbors Act. Alternative 2-3E conforms to this ARAR.

Executive Order 11,988. Executive Order 11,988 requires that the natural and beneficial values of floodplains be restored and preserved in the management of Federal lands. Since RASS 2 contains a significant amount of floodplains,

Executive Order 11,988 is an applicable requirement for RASS 2. Excavation and filling activities conducted in the wetlands will be affected by the requirements of Executive Order 11,988 on Floodplain Management. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and the migration of such contamination. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 2-3E conforms to this ARAR.

Resource Conservation and Recovery Act (RCRA). The Resource Conservation and Recovery Act regulates the treatment, storage, and disposal of hazardous wastes. Although RASS 2 is not a RCRA site, the requirements of RCRA are relevant and appropriate to the concept of leaving contamination on-site. The RCRA requirements on closure and post-closure care of RCRA facilities in general, and landfills in particular, contain requirements affecting this alternative. These include requirements addressing post-closure care, property use, maintenance of site security, and monitoring (40 CFR 264 Subpart G).

In addition, activities conducted under this alternative will be affected by the requirements of 40 CFR 261, 40 CFR 262, 40 CFR 263, and 40 CFR 264. These requirements can be accommodated during the design process by ensuring that all requirements are addressed in project specifications. Alternative 2-3E conforms to this ARAR.

Endangered Species Act. The Endangered Species Act prohibits the taking of any endangered species, and requires that actions not be likely to jeopardize the continued existence of any endangered species or result in the destruction or adverse modification of the critical habitat of such species. Because RASS 1 includes significant habitat for endangered species, the Endangered Species Act is an applicable requirement for RASS 2. Excavation of the contaminated materials and filling will result in substantial short term impacts on the habitat and species currently residing on RASS 2. This short term impact will be offset by the long term improvement resulting from the removal of the contamination. The potential for severe short term impacts was a

factor in the development of the site specific cleanup criteria for this alternative. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 2-3E conforms to this ARAR.

The Clean Water Act. The Clean Water Act regulates the discharge of pollutants from point sources into the navigable waters of the United States and regulates the discharge of dredged or fill material from point sources into the waters of the United States. Because RASS 2 contains brackish water wetlands and streams, the requirements of the Clean Water Act that regulate the discharge of pollutants into the navigable waters of the United States are relevant and appropriate and the requirements of the Clean Water Act that regulate the discharge of dredged or fill material into the waters of the United States are applicable. Data collected during the RI indicated that there was a discharge of contaminants into the streams and wetlands in the RASS 2 area. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and migration of such contamination. The extent of the reduction in contaminant migration has not been quantified. Construction activities may result in temporary increases in sediment loads to the wetland areas of RASS 2. This possibility can be minimized through adequate design of the selected excavation method. Significant excursions above the Federal Water Quality Criteria during active remediation are not anticipated. Filling, after excavation, will result in substantial short term impacts to the wetlands. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. Alternative 2-3E partially conforms to this ARAR.

California Water Code. The California Water Code regulates the discharge of hazardous wastes into the waters of the State of California. Because RASS 2 contains brackish water wetlands and streams, the requirements of the California Water Code are relevant and appropriate. Data collected during the RI indicated that there was a discharge of contaminants into the streams and wetlands in the RASS 2 area. This discharge was found to be in excess of the water quality standards. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and migration of such contamination. The extent of the reduction in

contaminant migration has not been quantified. There is the possibility for the short term release of contamination during conduct of the remedial action; however, this potential can be reduced through adequate construction planning. Filling, after excavation, will result in substantial short term impacts on the wetlands. The extensive monitoring program would enable the evaluation of contaminant migration through the surface water pathway. Alternative 2-3E partially conforms to this ARAR.

California Health and Safety Code. The California Health and Safety Code provides guidance on the identification of hazardous materials through the use of the TTLC/STLC criteria. Because the TTLC/STLC criteria provide such guidance, the TTLC/STLC criteria are relevant and appropriate. Materials that exceed these criteria would be disposed of in accordance with appropriate regulations. All materials that exceed these criteria would be removed from the RASS under this alternative. This alternative will conform to this ARAR in respect to materials disposal. Contaminated materials that are left on-site will be evaluated through the extensive monitoring program. Alternative 1-3E partially conforms to this ARAR.

The California Fish and Game Code. The California Fish and Game Code prohibits the deposition of substances or materials where such substances or materials can pass into waters of the State of California that would have a detrimental effect on wildlife, and prohibits the taking of any endangered or threatened species of wildlife. Because RASS 2 includes significant habitat for endangered species, the requirements of the California Fish and Game Code are relevant and appropriate. Data collected in the RI indicated that there was a discharge of such substances or materials into RASS 2. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 2-3E conforms to this ARAR.

Based on present understanding of the relevant facts, it is anticipated that Alternative 2-3E will be able to attain or partially attain ARAR's. However, because the proposed soil washing process is not a demonstrated technology for

metals removal from soils, there is considerable uncertainty associated with the ability of this alternative to meet ARAR's. Therefore, the ARAR conformance rating of Alternative 2-3E is moderate.

Permitting Requirements. To date, no specific permitting requirements have been identified for Alternative 2-3E. However, permits or coordination with appropriate agencies may be required for excavation and filling in wetlands and transportation of contaminated materials. The possibility exists that a permit may be required for the contaminated soil treatment facility. Discharges from the contaminated soil treatment facility will probably require a NPDES/SPDES permit for discharge of treated waste waters. The permitting requirement rating for Alternative 2-3E is low.

Legal Constraints. The ESA may present obstacles to the acceptance of this alternative. Consultation with appropriate agencies during the preparation of project plans and specifications can ensure that concerns are addressed. Contamination of adjacent properties, not under Navy ownership or control, is suspected. The Navy does not have access to remediate this contamination. Therefore, the legal constraint rating for Alternative 2-3E is moderate.

Cultural Resources. No significant cultural resources would be impacted by Alternative 2-3E.

Based on the evaluations presented above, the overall institutional rating for Alternative 2-3E is moderate.

7.3.2.7 Alternative 2-3F

Conformance To ARAR

Executive Order 11,990. Executive Order 11,990 requires that the destruction, loss, or degradation of wetlands be minimized and the natural and beneficial values of wetlands be enhanced in the management of Federal lands. Because RASS 2 contains a significant amount of brackish water wetlands (4.11 acres), Executive Order 11,990 concerning protection of wetlands is an applicable requirement for RASS 2. Excavation activities conducted under this

alternative will have a significant impact on the wetlands. Proper design and implementation of safeguards during the construction period will limit impacts consistent with the balancing of short term and long term impacts. The extent of excavation has been limited by the selection of an active remediation area that contains the highest level of contamination and takes into account topographic features of the site. A wetland restoration element has been included in this alternative. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and the migration of such contamination. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on site. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 2-3F conforms to this ARAR.

Rivers and Harbors Act of 1899. The Rivers and Harbors Act of 1899 regulates the excavation and filling of the navigable waters of the United States. Excavation activities in the wetland areas may fall within the "navigable waters of the United States," regulated under Section 10 of the Rivers and Harbors Act. Alternative 2-3F conforms to this ARAR.

Executive Order 11,988. Executive Order 11,988 requires that the natural and beneficial values of floodplains be restored and preserved in the management of Federal lands. Since RASS 2 contains a significant amount of floodplains, Executive Order 11,988 is an applicable requirement for RASS 2. Excavation and filling activities conducted in the wetlands will be affected by the requirements of Executive Order 11,988 on Floodplain Management. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and the migration of such contamination. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 2-3F conforms to this ARAR.

Resource Conservation and Recovery Act (RCRA). The Resource Conservation and Recovery Act regulates the treatment, storage, and disposal of hazardous

wastes. Although RASS 2 is not a RCRA site, the requirements of RCRA are relevant and appropriate to the concept of leaving contamination on-site. The RCRA requirements on closure and post-closure care of RCRA facilities in general, and landfills in particular, contain requirements affecting this alternative. These include requirements addressing post-closure care, property use, maintenance of site security, and monitoring (40 CFR 264 Subpart G).

In addition, activities conducted under this alternative will be affected by the requirements of 40 CFR 261, 40 CFR 262, 40 CFR 263, and 40 CFR 264. These requirements can be accommodated during the design process by ensuring that all requirements are addressed in project specifications. Alternative 2-3F conforms to this ARAR.

Endangered Species Act. The Endangered Species Act prohibits the taking of any endangered species, and requires that actions not be likely to jeopardize the continued existence of any endangered species or result in the destruction or adverse modification of the critical habitat of such species. Because RASS 1 includes significant habitat for endangered species, the Endangered Species Act is an applicable requirement for RASS 2. Excavation of the contaminated materials and filling will result in substantial short term impacts on the habitat and species currently residing on RASS 2. This short term impact will be offset by the long term improvement resulting from the removal of the contamination. The potential for severe short term impacts were a factor in the development of the site specific cleanup criteria for this alternative. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 2-3F conforms to this ARAR.

The Clean Water Act. The Clean Water Act regulates the discharge of pollutants from point sources into the navigable waters of the United States and regulates the discharge of dredged or fill material from point sources into the waters of the United States. Because RASS 2 contains brackish water wetlands and streams, the requirements of the Clean Water Act that regulate the discharge of pollutants into the navigable waters of the United States are relevant and appropriate and the requirements of the Clean Water Act that regulate the discharge of dredged or fill material into the waters of the

United States are applicable. Data collected during the RI indicated that there was a discharge of contaminants into the streams and wetlands in the RASS 2 area. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and migration of such contamination. The extent of the reduction in contaminant migration has not been quantified. Construction activities may result in temporary increases in sediment loads to the wetland areas of RASS 2. This possibility can be minimized through adequate design of the selected excavation method. Significant excursions above the Federal Water Quality Criteria during active remediation are not anticipated. Filling, after excavation, will result in substantial short term impacts to the wetlands. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. Alternative 2-3F partially conforms to this ARAR.

California Water Code. The California Water Code regulates the discharge of contaminants into the waters of the State. Because RASS 2 contains brackish water wetlands and streams, the requirements of the California Water Code are relevant and appropriate. Data collected during the RI indicated that there was a discharge of contaminants into the streams and wetlands in the RASS 2 area. This discharge was found to be in excess of the water quality standards. The partial removal of contamination by the remedial action involved in this alternative will reduce the amount of on site contamination and the migration of such contamination. The extent of the reduction in contaminant migration has not been quantified. There is the possibility for the short term release of contamination during conduct of the remedial action; however, this potential can be reduced through adequate construction planning. Filling, after excavation, will result in substantial short term impacts on the wetlands. The extensive monitoring program would enable the evaluation of contaminant migration through the surface water pathway and impacts on wetlands. Alternative 2-3F partially conforms to this ARAR.

California Health and Safety Code. The California Health and Safety Code provides guidance on the identification of hazardous materials through the use of the TTLC/STLC criteria. Because the TTLC/STLC criteria provide such guidance, the TTLC/STLC criteria are relevant and appropriate. Materials that exceed these criteria would be disposed of in accordance with appropriate

regulations. If a monofill is constructed for the treated soils, the State solid waste disposal facility criteria would be applicable to the location, construction, and operation of the facility. All materials that exceed these criteria would be removed under this alternative. This alternative will conform to this ARAR in respect to materials disposal. Contaminated materials left on-site will be evaluated through the extensive monitoring program. Alternative 2-3F partially conforms to this ARAR.

The California Fish and Game Code. The California Fish and Game Code prohibits the deposition of substances or materials where such substances or materials can pass into waters of the State of California that would have a detrimental effect on wildlife, and prohibits the taking of any endangered or threatened species of wildlife. Because RASS 2 includes significant habitat for endangered species, the requirements of the California Fish and Game Code are relevant and appropriate. Data collected in the RI indicated that there was a discharge of such substances or materials into RASS 2. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. Alternative 2-3F conforms to this ARAR.

Based on present understanding of the relevant facts, it is anticipated that Alternative 2-3F will be able to attain or partially attain ARAR's. In those cases where partial ARAR's conformance is attained, an environmental impacts waiver has been applied following the balancing of short and long term impacts of remediation with leaving contamination on site. The ARAR conformance rating of Alternative 2-3F is moderate.

Permitting Requirements. To date, no specific permitting requirements have been identified for Alternative 2-3F. However, permits or coordination with appropriate agencies may be required for excavation and filling in wetlands and transportation of contaminated materials. The possibility exists that a permit may be required for the contaminated soil treatment facility and/or the monofill proposed for construction on NWS Concord. Discharges from the contaminated soil treatment facility will probably require a NPDES/SPDES permit for discharge of treated waste waters. The permitting requirement rating for Alternative 2-3F is low.

Legal Constraints. The ESA may present obstacles to the acceptance of this alternative. Consultation with appropriate agencies during the preparation of project plans and specifications can ensure that concerns are addressed. Contamination of adjacent properties, not under Navy ownership or control, is suspected. The Navy does not have access to remediate this contamination. Therefore, the legal constraint rating for Alternative 2-3F is moderate.

Cultural Resources. No significant cultural resources would be impacted by this alternative.

Based on the evaluations presented above, the overall institutional rating for Alternative 2-3F is low.

The institutional requirements evaluation for RASS 2 is summarized in Table 7.17.

7.3.3 Remedial Action Subsite 3

7.3.3.1 Alternative 3-1

ARAR's identified for RASS 3 are summarized in Table 7.18

Conformance To ARAR

Executive Order 11,990. Executive Order 11,990 requires that the destruction, loss, or degradation of wetlands be minimized and the natural and beneficial values of wetlands be enhanced in the management of Federal lands. Since RASS 3 contains a significant amount of freshwater wetlands (8.78 acres), Executive Order 11,990 concerning protection of wetlands is an applicable requirement for RASS 3. The no action alternative leaves significant levels of contamination on RASS 3 and is expected to continue to have adverse impacts on the animal and vegetative populations on the RASS. In addition, the migration of contaminants from RASS 3 may adversely impact wetlands in RASS's 1 and 2. Alternative 3-1 does not conform to this ARAR.

Table 7.17

Institutional Requirements Evaluation of Remedial Alternatives for RASS 2

Remedial Alternatives		Evaluation Criteria: Conformance to ARAR	Permitting Requirements	Legal Constraints	Impact on Historic and Cultural Resources	Overall Rating
Alternative 2-1:	No Action	Low	High	Low	None	Low
Alternative 2-2:	Environmental Monitoring	Low	High	Moderate	None	Low
Alternative 2-3A:	Excavation/Disposal At Existing Landfills/ Restoration	High	High	Moderate	None	High
Alternative 2-3C:	Excavation/ Immobilization/ Disposal At Existing Landfills/Restoration	High	Moderate	Moderate	None	Moderate
Alternative 2-3D:	Excavation/ Immobilization/ Disposal At Monofill on NWS Concord/ Restoration	High	Moderate	Moderate	None	Moderate
Alternative 2-3E:	Excavation/Soil Washing/Disposal At Existing Landfill/ Restoration	Moderate	Low	Moderate	None	Low
Alternative 2-3F:	Excavation/Soil Washing/Disposal At Monofill on NWS Concord/Restoration	Moderate	Low	Moderate	None	Low

Table 7.18

Summary of ARAR's Analysis for RASS 3

	FCWA* (404)	FCWA* (402)	SWDA*	ESA* (7)	ESA* (9)	SDWA*	RHA*	E.O.* 11,990	E.O.* 11,988	CHSC*	CWC*	CFGC*	CPRC*
Locational													
Upland													
Waters											A	R	
Stream											R		
Wetlands	R							A	A		R		
Adjacent to Bay	R							A	A		R		
Adjacent to Stream	R							A	A		R		
Endangered Species Habitat				A	A							A	
Other Habitat													
Chemicals													
Arsenic		R	R			R				R	R	R	
Cadmium		R	R			R				R	R	R	
Copper		R	R			R				R	R	R	
Lead		R	R			R				R	R	R	
Selenium		R	R			R				R	R	R	
Zinc		R	R			R				R	R	R	
Remedial Action													
Excavation of Soil													
From Upland													
From Wetland													
From Endangered Species								A	A			A	
Habitat				A	A								
From Other Habitat													
Removal of Soil								A	A				A
Off-site Transport of Soil													
Off-site Disposal of Soil			A							A			
Backfilling in Wetlands	A							A	A		A	R	A
Backfilling in Uplands									A				

* FCWA = Federal Clean Water Act
SWDA = Solid Waste Disposal Act
ESA = Endangered Species Act
SDWA = Safe Drinking Water Act
RHA = Rivers & Harbors Act

E.O. = Executive Order
CHSC = California Health & Safety Code
CWC = California Water Code
CFGC = California Fish & Game Code
CPRC = California Public Resources Code

A = Applicable
R = Relevant or Appropriate
() = Operative Section

Resource Conservation and Recovery Act (RCRA). The Resource Conservation and Recovery Act regulates the treatment, storage, and disposal of hazardous wastes. Although RASS 3 is not a RCRA site, the requirements of RCRA are relevant and approprite to the concept of leaving contamination on-site. The RCRA requirements on closure and post-closure care of RCRA facilities in general, and landfills in particular, contain requirements affecting this alternative. These include requirements addressing post-closure care, property use, maintenance of site security, and monitoring (40 CFR 264 Subpart G). Alternative 3-1 does not conform to this ARAR.

Endangered Species Act. The Endangered Species Act prohibits the taking of any endangered species, and requires that actions not be likely to jeopardize the continued existence of any endangered species or result in the destruction or adverse modification of the critical habitat of such species. Because migration of contamination from RASS 3 may impact RASS's 1 and 2, which are known to include significant habitat for endangered species, the Endangered Species Act is an applicable requirement for RASS 3. Failure to remove known high levels of contamination may have an adverse impact on those species that inhabit RASS's 1 and 2. Alternative 3-1 does not conform to this ARAR.

The Clean Water Act. The Clean Water Act regulates the discharge of pollutants from point sources into the navigable waters of the United States. Because RASS 3 contains freshwater wetlands and streams, the requirements of the Clean Water Act are relevant and appropriate. Data collected during the RI documented the migration of contamination through the surface water pathway. Concentrations of metals in excess of ambient water quality standards were documented. Leaving the contaminants in-place will result in the continued migration of metals into the surface water. Alternative 3-1 does not conform to this ARAR.

California Water Code. The California Water Code regulates the discharge of hazardous wastes into the waters of the State. Because RASS 3 contains freshwater wetlands, the requirements of the California Water Code are relevant and appropriate. Data collected during the RI indicated that there was a discharge of hazardous waste into wetlands in the RASS 3 area. This discharge was found to be in excess of the water quality standards. Alternative 3-1 does not conform to this ARAR.

California Health and Safety Code. The California Health and Safety Code provides guidance on the identification of hazardous materials through the use of the TTLC/STLC criteria. Because the TTLC/STLC criteria provide such guidance, the TTLC/STLC criteria are relevant and appropriate. Materials exceeding these criteria have been identified on RASS 3 and would be left in place under this alternative. Alternative 3-1 does not conform to this ARAR.

The California Fish and Game Code. The California Fish and Game Code prohibits the deposition of substances or materials where such substances or materials can pass into waters of the State of California that would have a detrimental effect on wildlife, and prohibits the taking of any endangered or threatened species of wildlife. Because contamination on RASS 3 may impact habitat for wildlife on RASS 3 and migration of contaminants from RASS 3 may impact endangered species found on RASS's 1 and 2, the requirements of the California Fish and Game Code are relevant and appropriate. Data collected in the RI indicated that there was a discharge of such substances or materials into RASS 3. Alternative 3-1 does not conform to this ARAR.

Based on present understanding of the relevant facts, it is anticipated that Alternative 3-1 will be unable to attain ARAR's primarily because of the substantial quantities of contaminated materials left on RASS 3. The ARAR conformance rating for Alternative 3-1 is low.

Permitting Requirements. No permitting requirements have been identified to date for Alternative 3-1. Since no permitting requirements have been identified, the permit requirement rating of Alternative 3-1 is high.

Legal Constraints. Because contamination is left in-place, the ESA may present obstacles to the acceptance of this alternative. Therefore, the legal constraint rating for Alternative 3-1 rating is low.

Cultural Resources. No significant cultural resources would be impacted by Alternative 3-1.

Based on the evaluations presented above, the overall institutional rating for Alternative 3-1 is low.

7.3.3.2 Alternative 3-2

Conformance To ARAR

Executive Order 11,990. Executive Order 11,990 requires that the destruction, loss, or degradation of wetlands be minimized and the natural and beneficial values of wetlands be enhanced in the management of Federal lands. Since RASS 1 contains a significant amount of freshwater wetlands (8.78 acres), Executive Order 11,990 concerning protection of wetlands is an applicable requirement for RASS 3. The environmental monitoring alternative leaves significant levels of contamination on RASS 3 and is expected to continue to have adverse impacts on the animal and vegetative populations on the RASS. In addition, migration of contamination from RASS 3 may adversly impact wetlands found in RASS's 1 and 2. Implementation of an extensive environmental monitoring program will aid in the identification and evaluation of adverse impacts; however, such a monitoring program will not remove existing contamination nor prevent the continued migration of contamination. Alternative 3-2 does not conform to this ARAR.

Resource Conservation and Recovery Act (RCRA). The Resource Conservation and Recovery Act regulates the treatment, storage, and disposal of hazardous wastes. Although RASS 3 is not a RCRA site per se, RCRA requirements on closure and post-closure care of RCRA facilities in general, and landfills in particular, contain requirements that are relevant and appropriate to this alternative. These include requirements addressing post-closure care, property use, maintenance of site security, and monitoring (40 CFR 264 Subpart G). Although this alternative may be designed to meet most of these concerns, the fact that significant levels of contamination will be allowed to remain on-site may raise significant RCRA concerns. Alternative 3-2 would only partially conform to this ARAR.

Endangered Species Act. The Endangered Species Act prohibits the taking of any endangered species, and requires that actions not be likely to jeopardize the continued existence of any endangered species or result in the destruction or adverse modification of the critical habitat of such species. Because migration of contamination from RASS 3 may impact endangered species found on

RASS's 1 and 2, the Endangered Species Act is an applicable requirement for RASS 3. Failure to remove known high levels of contamination would have an adverse impact on those species inhabiting RASS's 1 and 2. Although the environmental monitoring alternative will document these impacts, the impacts will continue to occur. Alternative 3-2 will only partially conform to this ARAR.

The Clean Water Act. The Clean Water Act regulates the discharge of pollutants from point sources into the navigable waters of the United States. Because RASS 3 contains freshwater wetlands, the requirements of the Clean Water Act are relevant and appropriate. Data collected during the RI documented the migration of contamination through the surface water pathway. Concentrations of metals in excess of ambient water quality standards were documented. Leaving the contaminants in-place will result in the continued migration of metals into the surface water. Monitoring will provide information on the migration of contaminants; however, monitoring will not prevent the continued migration of contamination. Alternative 3-2 does not conform to this ARAR.

California Water Code. The California Water Code regulates the discharge of hazardous waste into the waters of the State of California. Because RASS 3 contains freshwater wetlands and streams, the requirements of the California Water Code are relevant and appropriate. Data collected during the RI indicated that there was a discharge of hazardous substances into the streams and wetlands in the RASS 3 area. This discharge was found to be in excess of the water quality standards. An extensive monitoring program would enable the evaluation of contaminant migration through the surface water pathway; however, it would not prevent such migration. Alternative 3-2 does not conform to this ARAR.

California Health and Safety Code. The California Health and Safety Code provides guidance on the identification of hazardous materials through the use of the TTLC/STLC criteria. Because the TTLC/STLC criteria provide such guidance, the TTLC/STLC criteria are relevant and appropriate. Materials exceeding these criteria have been identified on RASS 3 and would be left in place under this alternative. Alternative 3-2 may not conform to this ARAR.

The California Fish and Game Code. The California Fish and Game Code prohibits the deposition of substances or materials where such substances or materials can pass into waters of the State of California that would have a detrimental effect on wildlife, and prohibits the taking of any endangered or threatened species of wildlife. Because contamination left on RASS 3 would impact wildlife inhabiting RASS 3 and migration of contamination from RASS 3 would adversly impact habitat for endangered species found on RASS's 1 and 2, the requirements of the California Fish and Game Code are relevant and appropriate. Data collected in the RI indicated that there was a discharge of such substances or materials into RASS 3. The monitoring program would provide detailed information on the environmental effects of the hazardous substances that have been discharged onto RASS 3, however, would not prevent continuation of the impacts. Alternative 3-2 would not conform to this ARAR.

Based on present understanding of the relevant facts, it is anticipated that Alternative 3-2 will be unable to attain ARAR's primarily because of the substantial quantities of contaminated materials left on RASS 3. The ARAR conformance rating of Alternative 3-2 is low.

Permitting Requirements. No permitting requirements have been identified to date for Alternative 3-2. Since no permitting requirements have been identified, the permitting requirement rating for Alternative 3-2 is high.

Legal Constraints. The ESA may present obstacles to the acceptance of this alternative. In addition, there is suspected contamination along the boundary of RASS 3 on property that is not owned by the Navy. This property will need to be included in the monitoring program; however, the Navy does not have access to the property. Therefore, the legal constraint rating for Alternative 3-2 is low.

Cultural Resources. No significant cultural resources would be impacted by Alternative 3-2.

Based on the evaluations presented above, the overall institutional rating for Alternative 3-2 is low.

7.3.3.3 Alternative 3-3A

Conformance To ARAR

Executive Order 11,990. Executive Order 11,990 requires that the destruction, loss, or degradation of wetlands be minimized and the natural and beneficial values of wetlands be enhanced in the management of Federal lands. Since RASS 1 contains a significant amount of freshwater wetlands (8.78 acres), Executive Order 11,990 concerning protection of wetlands is an applicable requirement for RASS 3. Excavation and filling activities conducted under this alternative will have a significant impact on the wetlands. Proper design and implementation of safeguards during the construction period will limit impacts consistent with the balancing of short term and long term impacts. The extent of excavation has been limited by the selection of an active remediation area that contains the highest levels of contamination and takes into account topographic features of the site. Wetlands are expected to naturally recover. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and the migration of such contamination. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. The potential for severe short term impacts was a factor in the development of the site specific cleanup criteria for this alternative. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 3-3A conforms to this ARAR.

Rivers and Harbors Act of 1899. The Rivers and Harbors Act of 1899 regulates the excavation and filling of the navigable waters of the United States. Excavation activities in the wetland areas may fall within the "navigable waters of the United States," regulated under Section 10 of the Rivers and Harbors Act. Balancing of short term and long term impacts is consistent with this ARAR. Alternative 3-3A conforms to this ARAR.

Executive Order 11,988. Executive Order 11,988 requires that the natural and beneficial values of floodplains be restored and preserved in the management of Federal lands. Since RASS 3 contains a significant amount of floodplains,

Executive Order 11,988 is an applicable requirement for RASS 3. Excavation and filling activities conducted in the wetlands will be affected by the requirements of Executive Order 11,988 on Floodplain Management. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and the migration of such contamination. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. The potential for severe short term impacts was a factor in the development of the site specific cleanup criteria for this alternative. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 3-3A conforms to this ARAR.

Resource Conservation and Recovery Act (RCRA). The Resource Conservation and Recovery Act regulates the treatment, storage, and disposal of hazardous wastes. Although RASS 3 is not a RCRA site, the requirements of RCRA are relevant and approprite to the concept of leaving contamination on-site. The RCRA requirements on closure and post-closure care of RCRA facilities in general, and landfills in particular, contain requirements affecting this alternative. These include requirements addressing post-closure care, property use, maintenance of site security, and monitoring (40 CFR 264 Subpart G). Activities conducted under this alternative will be affected by the requirements of 40 CFR 261, 40 CFR 262, and 40 CFR 263. These requirements can be accomodated during the design process by ensuring that all requirements are addressed in project specifications.

Excavation and off-site transportation of contaminated materials will trigger the requirement to meet applicable Department of Transportation regulations. The transport of contaminated materials can be accomplished in accordance with such regulations. Excavation of wetland materials may trigger the RCRA ban on the landfilling of materials containing free liquids. Alternative 3-3A conforms to this ARAR.

Endangered Species Act. The Endangered Species Act prohibits the taking of any endangered species, and requires that actions not be likely to jeopardize the continued existence of any endangered species or reault in the destruction

or adverse modification of the critical habitat of such species. Because construction activities on RASS 3 may impact RASS's 1 and 2, which includes significant habitat for endangered species, the Endangered Species Act is an applicable requirement for RASS 3. Excavation of the contaminated materials and filling will result in substantial short term impacts on the habitat and species currently residing on RASS 3. This short term impact will be offset by the long term improvement resulting from the removal of the contamination. The potential for severe short term impacts was a factor in the development of the site specific cleanup criteria for this alternative. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 3-3A conforms to this ARAR.

The Clean Water Act. The Clean Water Act regulates the discharge of pollutants from point sources into the navigable waters of the United States and regulates the discharge of dredged or fill material from point sources into the waters of the United States. Because RASS 3 contains freshwater wetlands and streams, the requirements of the Clean Water Act which regulate the discharge of pollutants into the navigable waters of the United States are relevant and appropriate and the requirements of the Clean Water Act which regulate the discharge of dredged or fill material into the waters of the United States are applicable. Data collected during the RI indicated that there was a discharge of contaminants into the streams and wetlands in the RASS 3 area. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and migration of such contamination. The extent of the reduction in contaminant migration has not been quantified. Construction activities may result in temporary increases in sediment and contaminant loads to the wetland areas of RASS 3. This possibility can be minimized through adequate design of the selected excavation method. Significant excursions above the Federal Ambient Water Quality Criteria during active remediation are not anticipated. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on- site. Alternative 3-3A partially conforms to this ARAR.

California Water Code. The California Water Code regulates the discharge of hazardous wastes into the waters of the State of California. Because RASS 3

contains freshwater wetlands and streams, the requirements of the California Water Code are relevant and appropriate. Data collected during the RI indicated that there was a discharge of contaminants into the streams and wetlands in the RASS 3 area. This discharge was found to be in excess of the water quality standards. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and migration of such contamination. The extent of the reduction in contaminant migration has not been quantified. There is the possibility for the short term release of contamination during conduct of the remedial action; however, this potential can be minimized through adequate construction planning. The extensive monitoring program would enable the evaluation of contaminant migration through the surface water pathway and impacts on the wetlands. Alternative 3-3A partially conforms to this ARAR.

California Health and Safety Code. The California Health and Safety Code provides guidance on the identification of hazardous materials through the use of the TTLC/STLC criteria. Because the TTLC/STLC criteria provide such guidance, the TTLC/STLC criteria are relevant and appropriate. Materials that exceed these criteria would be disposed of in accordance with appropriate regulations. All materials that exceed these criteria would be removed under this alternative. This alternative will conform to this ARAR in respect to materials disposal. Although significant quantities of contaminants are removed by this alternative, some contaminated materials would be left on site. Such materials that are left on site will be evaluated through the extensive monitoring program. Alternative 3-3A partially conforms to this ARAR.

The California Fish and Game Code. The California Fish and Game Code prohibits the deposition of substances or materials where such substances or materials can pass into waters of the State of California that would have a detrimental effect on wildlife, and prohibits the taking of any endangered or threatened species of wildlife. Because RASS 3 includes wetland habitat and activities on RASS 3 may impact RASS's 1 and 2, which contain significant habitat for endangered species, the requirements of the California Fish and Game Code are relevant and appropriate. Data collected in the RI indicated that there was a discharge of such substances or materials into RASS 3. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and the migration

of such contamination. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. Alternative 3-3A would conform to this ARAR.

Based on present understanding of the relevant facts, it is anticipated that Alternative 3-3A will be able to attain or partially attain ARAR's. In those cases where partial ARAR's conformance is attained, an environmental impacts waiver has been applied following the balancing of short and long term impacts of remediation with leaving contamination on site. The ARAR conformance rating for Alternative 3-3A is high.

Permitting Requirements. No specific permitting requirements have been identified to date for Alternative 3-3A. However, permits or coordination with appropriate agengies may be required for excavation and filling in wetlands and transportation of contaminated materials. The permitting requirement rating for Alternative 3-3A is high.

Legal Constraints. The ESA may present obstacles to the acceptance of this alternative. Consultation with appropriate agencies during the preparation of project plans and specifications can ensure that concerns are addressed. Contamination of adjacent properties, not under Navy ownership or control is suspected. The Navy does not have access to remediate this contamination. Therefore, the legal constraint rating for Alternative 3-3A is moderate.

Cultural Resources. No significant cultural resources would be impacted by Alternative 3-3A.

Based on the evaluations presented above, the overall institutional rating for Alternative 3-1 is high.

7.3.3.4 Alternative 3-3C

Conformance To ARAR

Executive Order 11,990. Executive Order 11,990 requires that the destruction, loss, or degradation of wetlands be minimized and the natural and beneficial values of wetlands be enhanced in the management of Federal lands. Since

RASS 3 contains a significant amount of freshwater wetlands (8.78 acres), Executive Order 11,990 concerning protection of wetlands is an applicable requirement for RASS 3. Excavation and filling activities conducted under this alternative will have a significant impact on the wetlands. Proper design and implementation of safeguards during the construction period will limit impacts consistent with the balancing of short term and long term impacts. The extent of excavation has been limited by the selection of an active remediation area that contains the highest level of contamination and takes into account topographic features of the site. Wetlands will naturally recover. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and the migration of such contamination. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site.

The potential for severe short term impacts was a factor in the development of the site specific cleanup criteria for this alternative. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 3-3C conforms to this ARAR.

Rivers and Harbors Act of 1899. The Rivers and Harbors Act of 1899 regulates the excavation and filling of the navigable waters of the United States. Excavation activities in the wetland areas may fall within the "navigable waters of the United States," regulated under Section 10 of the Rivers and Harbors Act. Alternative 3-3C conforms to this ARAR.

Executive Order 11,988. Executive Order 11,988 requires that the natural and beneficial values of floodplains be restored and preserved in the management of Federal lands. Since RASS 3 contains a significant amount of floodplains, Executive Order 11,988 is an applicable requirement for RASS 3. Excavation and filling activities conducted in the wetlands will be affected by the requirements of Executive Order 11,988 on Floodplain Management. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and the migration of such contamination. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left

on-site. The potential for severe short term impacts was a factor in the development of the site specific cleanup criteria for this alternative. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 3-3C would conform to this ARAR.

Resource Conservation and Recovery Act (RCRA). The Resource Conservation and Recovery Act regulates the treatment, storage, and disposal of hazardous wastes. Although RASS 3 is not a RCRA site, the requirements of RCRA are relevant and approprite to the concept of leaving contamination on-site. The RCRA requirements on closure and post-closure care of RCRA facilities in general, and landfills in particular, contain requirements affecting this alternative. These include requirements addressing post-closure care, property use, maintenance of site security, and monitoring (40 CFR 264 Subpart G).

The purpose of the on-site stabilization/solidification plant is to immobilize certain metals in the contaminated soils and sediments. Therefore, the regulations governing owners and operators of hazardous waste treatment facilities would be relevant and appropriate. Activities conducted under this alternative will be affected by the requirements of 40 CFR 261, 40 CFR 262, 40 CFR 263, and 40 CFR 264. These requirements can be accomodated during the design process by ensuring that all requirements are addressed in project specifications.

Excavation of wetland materials may trigger the ban on the landfilling of materials containing free liquids. The proposed stabilization/solidification process should eliminate this possibility. Alternative 3-3C would conform to this ARAR.

Endangered Species Act. The Endangered Species Act prohibits the taking of any endangered species, and requires that actions not be likely to jeopardize the continued existence of any endangered species or result in the destruction or adverse modification of the critical habitat of such species. Because construction activities on RASS 3 may impact RASS's 1 and 2, which includes significant habitat for endangered species, the Endangered Species Act is an applicable requirement for RASS 3. Excavation of the contaminated materials will result in substantial short term impacts on the habitat and species

currently residing on RASS 3. This short term impact will be offset by the long term improvement resulting from the removal of the contamination. The potential for severe short term impacts was a factor in the development of the site specific cleanup criteria for this alternative. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 3-3C conforms to this ARAR.

The Clean Water Act. The Clean Water Act regulates the discharge of pollutants from point sources into the navigable waters of the United States and regulates the discharge of dredged or fill material from point sources into the waters of the United States. Because RASS 3 contains freshwater wetlands and streams, the requirements of the Clean Water Act which regulate the discharge of pollutants into the navigable waters of the United States are relevant and appropriate and the requirements of the Clean Water Act which regulate the discharge of dredged or fill material into the waters of the United States are applicable. Data collected during the RI indicated that there was a discharge of contaminants into the streams and wetlands in the RASS 3 area. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and migration of such contamination. The extent of the reduction in contaminant migration has not been quantified. Construction activities may result in temporary increases in sediment loads to the wetland areas of RASS 3. This possibility can be minimized through adequate design of the selected excavation method. Significant excursions above the Federal Water Quality Criteria during active remediation are not anticipated. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. Alternative 3-3C partially conforms to this ARAR.

California Water Code. The California Water Code regulates the discharge of hazardous wastes into the waters of the State of California. Because RASS 3 contains freshwater wetlands and streams, the requirements of the California Water Code are relevant and appropriate. Data collected during the RI indicated that there was a discharge of contaminants into the streams and wetlands in the RASS 3 area. This discharge was found to be in excess of the water quality standards. The partial removal of contamination proposed by the

remedial action involved in this alternative would reduce the amount of contamination on site and migration of such contamination. The extent of the reduction in contaminant migration has not been quantified. There is the possibility for the short term release of contamination during conduct of the remedial action; however, this potential can be reduced through adequate construction planning. The extensive monitoring program would enable the evaluation of contaminant migration through the surface water pathway and impacts on the wetlands. Alternative 3-3C partially conforms to this ARAR.

California Health and Safety Code. The California Health and Safety Code provides guidance on the identification of hazardous materials through the use of the TTLC/STLC criteria. Because the TTLC/STLC criteria provide such guidance, the TTLC/STLC criteria are relevant and appropriate. All materials that exceed these criteria will be removed from RASS 3. Materials that exceed these criteria would be disposed of in accordance with appropriate regulations. The California Health and Safety Code also affects the treatment and disposal of materials excavated from the RASS. This alternative will conform to this ARAR in respect to materials disposal. Contaminated materials that are left on-site will be evaluated through the extensive monitoring program. Alternative 3-3C partially conforms to this ARAR.

The California Fish and Game Code. The California Fish and Game Code prohibits the deposition of substances or materials where such substances or materials can pass into waters of the State of California that would have a detrimental effect on wildlife, and prohibits the taking of any endangered or threatened species of wildlife. Because RASS 3 includes wetland habitat and activities on RASS 3 may impact RASS's 1 and 2, which include habitat for endangered species, the requirements of the California Fish and Game Code are relevant and appropriate. Data collected in the RI indicated that there was a discharge of such substances or materials into RASS 3. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and the migration of such contamination. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. Although some contamination will be left on-site, Alternative 3-3C would conform to this ARAR.

Based on present understanding of the relevant facts, it is anticipated that Alternative 3-3C will be able to attain or partially attain ARAR's. In those cases where partial ARAR's conformance is attained, an environmental impacts waiver has been applied following the balancing of short and long term impacts of remediation with leaving contamination on site. The ARAR conformance rating of Alternative 3-3C is high.

Permitting Requirements. To date, no specific permitting requirements have been identified for Alternative 3-3C. However, permits or coordination with appropriate agengies may be required for excavation and filling in wetlands and transportation of contaminated materials. The possibility exists that a permit may be required for the contaminated soil treatment facility. The permitting requirement rating for Alternative 3-3C is moderate.

Legal Constraints. The ESA may present obstacles to the acceptance of this alternative. Consultation with appropriate agencies during the preparation of project plans and specifications can ensure that concerns are addressed. Contamination of adjacent properties, not under Navy ownership or control, is suspected. The Navy does not have access to remediate this contamination. Therefore, the legal constraint rating for Alternative 3-3C is moderate.

Cultural Resources. No significant cultural resources would be impacted by Alternative 3-3C.

Based on the evaluations presented above, the overall institutional rating for Alternative 3-3C is moderate.

7.3.3.6 Alternative 3-3D

Conformance To ARAR

Executive Order 11,990. Executive Order 11,990 requires that the destruction, loss, or degradation of wetlands be minimized and the natural and beneficial values of wetlands be enhanced in the management of Federal lands. RASS 3 contains a significant amount of freshwater wetlands (8.78 acres). Excavation and filling activities conducted under this alternative will have a significant impact on the wetlands. Proper design and implementation of safeguards

during the construction period will limit impacts consistent with the balancing of short term and long term impacts. The extent of excavation has been limited by the selection of an active remediation area that contains the highest level of contamination and takes into account topographic features of the site. Wetlands will recover naturally. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and the migration of such contamination. The monitoring program would provide detailed information on the envoronmental effects of the remedial action and the contaminants left on- site. The potential for severe short term impacts was a factor in the development of the site specific cleanup criteria for this alternative. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 3- 3D conforms to this ARAR.

Rivers and Harbors Act of 1899. The Rivers and Harbors Act of 1899 regulates the excavation and filling of the navigable waters of the United States. Excavation activities in the wetland areas may fall within the "navigable waters of the United States," regulated under Section 10 of the Rivers and Harbors Act. Alternative 3-3D conforms to this ARAR.

Executive Order 11,988. Executive Order 11,988 requires that the natural and beneficial values of floodplains be restored and preserved in the management of Federal lands. Since RASS 3 contains a significant amount of floodplains, Executive Order 11,988 is an applicable requirement for RASS 3. Excavation activities conducted in the wetlands will be affected by the requirements of Executive Order 11,988 on Floodplain Management. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and the migration of such contamination. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. The potential for severe short term impacts was a factor in the development of the site specific cleanup criteria for this alternative. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 3-3D conforms to this ARAR.

Resource Conservation and Recovery Act (RCRA). The Resource Conservation and Recovery Act regulates the treatment, storage, and disposal of hazardous

wastes. Although RASS 3 is not a RCRA site, the requirements of RCRA are relevant and approprite to the concept of leaving contamination on-site. The RCRA requirements on closure and post-closure care of RCRA facilities in general, and landfills in particular, contain requirements affecting this alternative. These include requirements addressing post-closure care, property use, maintenance of site security, and monitoring (40 CFR 264 Subpart G).

In addition, activities conducted under this alternative including operation of the stabilization/solidification facility and the siting and construction of the monofill will be affected by the requirements of 40 CFR 261, 40 CFR 262, 40 CFR 263, and 40 CFR 264. These requirements can be accomodated during the design process by ensuring that all requirements are addressed in project specifications. Excavation of wetland materials may trigger the RCRA ban on the landfilling of materials containing free liquids. Alternative 3-3D conforms to this alternative.

Endangered Species Act. The Endangered Species Act prohibits the taking of any endangered species, and requires that actions not be likely to jeopardize the continued existence of any endangered species or result in the destruction or adverse modification of the critical habitat of such species. Because construction activities on RASS 3 may impact RASS's 1 and 2, which includes significant habitat for endangered species, the Endangered Species Act is an applicable requirement for RASS 3. Excavation of the contaminated materials will result in substantial short term impacts on the habitat and species currently residing on RASS 3. This short term impact will be offset by the long term improvement resulting from the removal of the contamination. The potential for severe short term impacts was a factor in the development of the site specific cleanup criteria for this alternative. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 3-3D conforms to this ARAR.

The Clean Water Act. The Clean Water Act regulates the discharge of pollutants from point sources into the navigable waters of the United States and regulates the discharge of dredged or fill material from point sources into the waters of the United States. Because RASS 3 contains freshwater wetlands and streams, the requirements of the Clean Water Act which regulate the discharge of pollutants into the navigable waters of the United States are

relevant and appropriate and the requirements of the Clean Water Act which regulate the discharge of dredged or fill material into the waters of the United States are applicable. Data collected during the RI indicated that there was a discharge of contaminants into the streams and wetlands in the RASS 3 area. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and migration of such contamination. The extent of the reduction in contaminant migration has not been quantified. Construction activities may result in temporary increases in sediment loads to the wetland areas of RASS 3. This possibility can be minimized through adequate design of the selected excavation method. Significant excursions above the Federal Water Quality Criteria during active remediation are not anticipated. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. Alternative 3-3D partially conforms to this ARAR.

California Water Code. The California Water Code regulates the discharge of contaminants into the waters of the State of California. Because RASS 3 contains freshwater wetlands and streams, the requirements of the California Water Code are relevant and appropriate. Data collected during the RI indicated that there was a discharge of contaminants into the streams and wetlands in the RASS 3 area. This discharge was found to be in excess of the water quality standards. The partial removal of contamination by the remediation involved in this alternative would reduce the contamination on site and the migration of such contamination. The extent of the reduction in contaminant migration has not been quantified. There is the possibility for the short term release of contamination during conduct of the remedial action; however, this potential can be reduced through adequate construction planning. The extensive monitoring program would enable the evaluation of contaminant migration through the surface water pathway and impacts on wetlands. Alternative 3-3D partially conforms to this ARAR.

California Health and Safety Code. The California Health and Safety Code provides guidance on the identification of hazardous materials through the use of the TTLC/STLC criteria. Because the TTLC/STLC criteria provide such guidance, the TTLC/STLC criteria are relevant and appropriate. The State solid waste disposal facility criteria would be applicable to the location, construction,

and operation of the facility. All materials that exceed these criteria would be removed from the RASS under this alternative. This alternative will conform to this ARAR in respect to materials disposal. Contaminated materials that are left on-site will be evaluated through the extensive monitoring program. Alternative 3-3D partially conforms to this ARAR.

The California Fish and Game Code. The California Fish and Game Code prohibits the deposition of substances or materials where such substances or materials can pass into waters of the State of California that would have a detrimental effect on wildlife, and prohibits the taking of any endangered or threatened species of wildlife. Because RASS 3 includes significant wetland habitat and activities on RASS 3 may impact RASS's 1 and 3, which include habitat for endangered species, the requirements of the California Fish and Game Code are relevant and appropriate. Data collected in the RI indicated that there was a discharge of such substances or materials into RASS 3. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and the migration of such contamination. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. Alternative 3-3D would conform to this ARAR.

Based on present understanding of the relevant facts, it is anticipated that Alternative 3-3D will be able to attain or partially attain ARAR's. In those cases where partial ARAR's conformance is attained, an environmental impacts waiver has been applied following the balancing of short and long term impacts of remediation with leaving contamination on site. The ARAR conformance rating for Alternative 3-3D is high.

Permitting Requirements. To date, no specific permitting requirements have been identified for Alternative 3-3D. However, permits or coordination with appropriate agengies may be required for excavation and filling in wetlands and transportation of contaminated materials. The possibility exists that a permit may be required for the contaminated soil treatment facility and/or the proposed monofill to be constructed on NWS Concord. The permitting requirement rating for Alternative 3-3D is moderate.

Legal Constraints. The ESA may present obstacles to the acceptance of this alternative. Consultation with appropriate agencies during the preparation of project plans and specifications can ensure that concerns are addressed. Contamination of adjacent properties, not under Navy ownership or control, is suspected. The Navy does not have access to remediate this contamination. Therefore, the legal constraint rating for Alternative 3-3D is moderate.

Cultural Resources. No significant cultural resources would be impacted by Alternative 3-3D.

Based on the evaluations presented above, the overall institutional rating for Alternative 3-3D is moderate.

7.3.3.7 Alternative 3-3E

Conformance To ARAR

Executive Order 11,990. Executive Order 11,990 requires that the destruction, loss, or degradation of wetlands be minimized and the natural and beneficial values of wetlands be enhanced in the management of Federal lands. Because RASS 3 contains a significant amount of freshwater wetlands (8.78 acres), Executive Order 11,990 concerning protection of wetlands is an applicable requirement for RASS 3. Excavation activities conducted under this alternative will have a significant impact on the wetlands. Proper design and implementation of safeguards during the construction period will limit impacts consistent with the balancing of short term and long term impacts. The extent of excavation has been limited by the selection of an active remediation area that contains the highest level of contamination and takes into account topographic features of the site. Wetlands will recover naturally. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and the migration of such contamination. The monitoring program would provide detailed information on the environmental effects of the remediation and the contaminants left on site. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 3-3E conforms to this ARAR.

Rivers and Harbors Act of 1899. The Rivers and Harbors Act of 1899 regulates the excavation and filling of the navigable waters of the United States. Excavation activities in the wetland areas may fall within the "navigable waters of the United States," regulated under Section 10 of the Rivers and Harbors Act. Alternative 3-3E conforms to this ARAR.

Executive Order 11,988. Executive Order 11,988 requires that the natural and beneficial values of floodplains be restored and preserved in the management of Federal lands. Since RASS 3 contains a significant amount of floodplains, Executive Order 11,988 is an applicable requirement for RASS 3. Excavation activities conducted in the wetlands will be affected by the requirements of Executive Order 11,988 on Floodplain Management. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and the migration of such contamination. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 3-3E conforms to this ARAR.

Resource Conservation and Recovery Act (RCRA). The Resource Conservation and Recovery Act regulates the treatment, storage, and disposal of hazardous wastes. Although RASS 3 is not a RCRA site, the requirements of RCRA are relevant and approprite to the concept of leaving contamination on-site. The RCRA requirements on closure and post-closure care of RCRA facilities in general, and landfills in particular, contain requirements affecting this alternative. These include requirements addressing post-closure care, property use, maintenance of site security, and monitoring (40 CFR 264 Subpart G).

In addition, activities conducted under this alternative will be affected by the requirements of 40 CFR 261, 40 CFR 262, 40 CFR 263, and 40 CFR 264. These requirements can be accomodated during the design process by ensuring that all requirements are addressed in project specifications. Alternative 3-3E conforms to this ARAR.

Endangered Species Act. The Endangered Species Act prohibits the taking of any endangered species, and requires that actions not be likely to jeopardize

the continued existence of any endangered species or result in the destruction or adverse modification of the critical habitat of such species. Because construction activities on RASS 3 may impact RASS's 1 and 2, which includes significant habitat for endangered species, the Endangered Species Act is an applicable requirement for RASS 3. Excavation of the contaminated materials will result in substantial short term impacts on the habitat and species currently residing on RASS 3. This short term impact will be offset by the long term improvement resulting from the removal of the contamination. The potential for severe short term impacts was a factor in the development of the site specific cleanup criteria for this alternative. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 3-3E conforms to this ARAR.

The Clean Water Act. The Clean Water Act regulates the discharge of pollutants from point sources into the navigable waters of the United States and regulates the discharge of dredged or fill material from point sources into the waters of the United States. Because RASS 3 contains freshwater wetlands and streams, the requirements of the Clean Water Act that regulate the discharge of pollutants into the navigable waters of the United States are relevant and appropriate and the requirements of the Clean Water Act that regulate the discharge of dredged or fill material into the waters of the United States are applicable. Data collected during the RI indicated that there was a discharge of contaminants into the streams and wetlands in the RASS 3 area. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and migration of such contamination. The extent of the reduction in contaminant migration has not been quantified. Construction activities may result in temporary increases in sediment loads to the wetland areas of RASS 3. This possibility can be minimized through adequate design of the selected excavation method. Significant excursions above the Federal Water Quality Criteria during active remediation are not anticipated. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. Alternative 3-3E partially conforms to this ARAR.

California Water Code. The California Water Code regulates the discharge of hazardous wastes into the waters of the State of California. Because RASS 3

contains freshwater wetlands and streams, the requirements of the California Water Code are relevant and appropriate. Data collected during the RI indicated that there was a discharge of contaminants into the streams and wetlands in the RASS 3 area. This discharge was found to be in excess of the water quality standards. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and migration of such contamination. The extent of the reduction in contaminant migration has not been quantified. There is the possibility for the short term release of contamination during conduct of the remedial action; however, this potential can be reduced through adequate construction planning. The extensive monitoring program would enable the evaluation of contaminant migration through the surface water pathway. Alternative 3-3E partially conforms to this ARAR.

California Health and Safety Code. The California Health and Safety Code provides guidance on the identification of hazardous materials through the use of the TTLC/STLC criteria. Because the TTLC/STLC criteria provide such guidance, the TTLC/STLC criteria are relevant and appropriate. Materials that exceed these criteria would be disposed of in accordance with appropriate regulations. All materials that exceed these criteria would be removed from the RASS under this alternative. This alternative will conform to this ARAR in respect to materials disposal. Contaminated materials that are left on-site will be evaluated through the extensive monitoring program. Alternative 1-3E partially conforms to this ARAR.

The California Fish and Game Code. The California Fish and Game Code prohibits the deposition of substances or materials where such substances or materials can pass into waters of the State of California that would have a detrimental effect on wildlife, and prohibits the taking of any endangered or threatened species of wildlife. Because RASS 3 includes significant wetland habitat and activities on RASS 3 may impact RASS's 1 and 2, which include habitat for endangered species, the requirements of the California Fish and Game Code are relevant and appropriate. Data collected in the RI indicated that there was a discharge of such substances or materials into RASS 3. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. This alternative would conform to this ARAR. The area selected for active remediation results

from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 3-3E conforms to this ARAR.

Based on present understanding of the relevant facts, it is anticipated that Alternative 3-3E will be able to attain or partially attain ARAR's. However, because the proposed soil washing process is not a demonstrated technology for metals removal from soils, there is considerable uncertainty associated with the ability of this alternative to meet ARAR's. Therefore, the ARAR conformance rating of Alternative 3-3E is moderate.

Permitting Requirements. To date, no specific permitting requirements have been identified for Alternative 3-3E. However, permits or coordination with appropriate agengies may be required for excavation and filling in wetlands and transportation of contaminated materials. The possibility exists that a permit may be required for the contaminated soil treatment facility. Discharges from the contaminated soil treatment facility will probably require a NPDES/SPDES permit for discharge of treated waste waters. The permitting requirement rating for Alternative 3-3E is low.

Legal Constraints. The ESA may present obstacles to the acceptance of this alternative. Consultation with appropriate agencies during the preparation of project plans and specifications can ensure that concerns are addressed. Contamination of adjacent properties, not under Navy ownership or control is suspected. The Navy does not have access to remediate this contamination. Therefore, the legal constraint rating for Alternative 3-3E is moderate.

Cultural Resources. No significant cultural resources would be impacted by Alternative 3-3E.

Based on the evaluations presented above, the overall institutional rating for Alternative 3-3E is low.

7.3.3.7 Alternative 3-3F

Conformance To ARAR

Executive Order 11,990. Executive Order 11,990 requires that the destruction, loss, or degradation of wetlands be minimized and the natural and beneficial values of wetlands be enhanced in the management of Federal lands. Because RASS 3 contains a significant amount of freshwater wetlands (8.78 acres), Executive Order 11,990 concerning protection of wetlands is an applicable requirement for RASS 3. Excavation activities conducted under this alternative will have a significant impact on the wetlands. Proper design and implementation of safeguards during the construction period will limit impacts consistent with the balancing of short term and long term impacts. The extent of excavation has been limited by the selection of an active remediation area that contains the highest level of contamination and takes into account topographic features of the site. Wetlands will recover naturally. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and the migration of such contamination. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on site. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 3-3F conforms to this ARAR.

Rivers and Harbors Act of 1899. The Rivers and Harbors Act of 1899 regulates the excavation and filling of the navigable waters of the United States. Excavation activities in the wetland areas may fall within the "navigable waters of the United States," regulated under Section 10 of the Rivers and Harbors Act. Alternative 3-3F conforms to this ARAR

Executive Order 11,988. Executive Order 11,988 requires that the natural and beneficial values of floodplains be restored and preserved in the management of Federal lands. Since RASS 3 contains a significant amount of floodplains, Executive Order 11,988 is an applicable requirement for RASS 3. Excavation and filling activities conducted in the wetlands will be affected by the requirements of Executive Order 11,988 on Floodplain Management. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and the migration of such contamination. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. The area selected for active remediation results from a balancing of

the short term adverse impacts with the potential for long term benefit. Alternative 3-3F conforms to this ARAR.

Resource Conservation and Recovery Act (RCRA). The Resource Conservation and Recovery Act regulates the treatment, storage, and disposal of hazardous wastes. Although RASS 3 is not a RCRA site, the requirements of RCRA are relevant and approprite to the concept of leaving contamination on-site. The RCRA requirements on closure and post-closure care of RCRA facilities in general, and landfills in particular, contain requirements affecting this alternative. These include requirements addressing post-closure care, property use, maintenance of site security, and monitoring (40 CFR 264 Subpart G).

In addition, activities conducted under this alternative will be affected by the requirements of 40 CFR 261, 40 CFR 262, 40 CFR 263, and 40 CFR 264. These requirements can be accomodated during the design process by ensuring that all requirements are addressed in project specifications. Alternative 3-3F conforms to this ARAR.

Endangered Species Act. The Endangered Species Act prohibits the taking of any endangered species, and requires that actions not be likely to jeopardize the continued existence of any endangered species or result in the destruction or adverse modification of the critical habitat of such species. Because construction activities on RASS 3 may impact RASS's 1 and 2, which includes significant habitat for endangered species, the Endangered Species Act is an applicable requirement for RASS 3. Excavation of the contaminated materials will result in substantial short term impacts on the habitat and species currently residing on RASS 3. This short term impact will be offset by the long term improvement resulting from the removal of the contamination. The potential for severe short term impacts was a factor in the development of the site specific cleanup criteria for this alternative. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 3-3F conforms to this ARAR.

The Clean Water Act. The Clean Water Act regulates the discharge of pollutants from point sources into the navigable waters of the United States and regulates the discharge of dredged or fill material from point sources into the waters of the United States. Because RASS 3 contains freshwater wetlands

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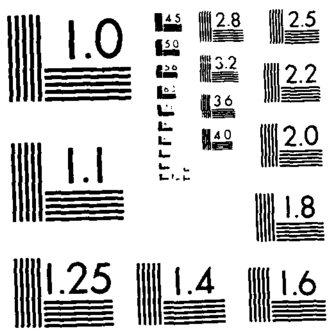
1.0
2.8
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3.2
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3.6
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1.6

and streams, the requirements of the Clean Water Act that regulate the discharge of pollutants into the navigable waters of the United States are relevant and appropriate and the requirements of the Clean Water Act that regulate the discharge of dredged or fill material into the waters of the United States are applicable. Data collected during the RI indicated that there was a discharge of contaminants into the streams and wetlands in the RASS 3 area. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and migration of such contamination. The extent of the reduction in contaminant migration has not been quantified. Construction activities may result in temporary increases in sediment loads to the wetland areas of RASS 3. This possibility can be minimized through adequate design of the selected excavation method. Significant excursions above the Federal Water Quality Criteria during active remediation are not anticipated. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. Alternative 3-3F partially conforms to this ARAR.

California Water Code. The California Water Code regulates the discharge of contaminants into the waters of the State. Because RASS 3 contains fresh water wetlands and streams, the requirements of the California Water Code are relevant and appropriate. Data collected during the RI indicated that there was a discharge of contaminants into the streams and wetlands in the RASS 3 area. This discharge was found to be in excess of the water quality standards. The partial removal of contamination by the remedial action involved in this alternative will reduce the amount of on site contamination and the migration of such contamination. The extent of the reduction in contaminant migration has not been quantified. There is the possibility for the short term release of contamination during conduct of the remedial action; however, this potential can be reduced through adequate construction planning. The extensive monitoring program would enable the evaluation of contaminant migration through the surface water pathway and impacts on wetlands. Alternative 3-3F partially conforms to this ARAR.

California Health and Safety Code. The California Health and Safety Code provides guidance on the identification of hazardous materials through the use of the TTLC/STLC criteria. Because the TTLC/STLC criteria provide such guidance,

the TTLC/STLC criteria are relevant and appropriate. Materials that exceed these criteria would be disposed of in accordance with appropriate regulations. If a monofill is constructed for the treated soils, the State solid waste disposal facility criteria would be applicable to the location, construction, and operation of the facility. All materials that exceed these criteria would be removed under this alternative. This alternative will conform to this ARAR in respect to materials disposal. Contaminated materials left on-site will be evaluated through the extensive monitoring program. Alternative 3-3F partially conforms to this ARAR.

The California Fish and Game Code. The California Fish and Game Code prohibits the deposition of substances or materials where such substances or materials can pass into waters of the State of California that would have a detrimental effect on wildlife, and prohibits the taking of any endangered or threatened species of wildlife. Because RASS 3 includes wetland habitat and activities on RASS 3 may impact RASS's 1 and 2, which include habitat for endangered species, the requirements of the California Fish and Game Code are relevant and appropriate. Data collected in the RI indicated that there was a discharge of such substances or materials into RASS 3. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. Alternative 3-3F conform to this ARAR.

Based on present understanding of the relevant facts, it is anticipated that Alternative 3-3F will be able to attain or partially attain ARAR's. In those cases where partial ARAR's conformance is attained, an environmental impacts waiver has been applied following the balancing of short and long term impacts of remediation with leaving contamination on site. The ARAR conformance rating of Alternative 3-3F is moderate.

Permitting Requirements. To date, no specific permitting requirements have been identified for Alternative 3-3F. However, permits or coordination with appropriate agengies may be required for excavation and filling in wetlands and transportation of contaminated materials. The possibility exists that a permit may be required for the contaminated soil treatment facility and/or the monofill proposed for construction on NWS Concord. Discharges from the contaminated soil treatment facility will probably require a NPDES/SPDES permit

for discharge of treated waste waters. The permitting requirement rating for Alternative 3-3F is low.

Legal Constraints. The ESA may present obstacles to the acceptance of this alternative. Consultation with appropriate agencies during the preparation of project plans and specifications can ensure that concerns are addressed. Contamination of adjacent properties, not under Navy ownership or control, is suspected. The Navy does not have access to remediate this contamination. Therefore, the legal constraint rating for Alternative 3-3F is moderate.

Cultural Resources. No significant cultural resources would be impacted by this alternative.

Based on the evaluations presented above, the overall institutional rating for Alternative 3-3F is low.

The institutional requirements evaluation for RASS 3 remedial action alternatives is summarized in Table 7.19.

7.3.4 Remedial Action Subsite 4

7.3.4.1 Alternative 4-1

ARAR's identified for RASS 4 are summarized in Table 7.20

Conformance To ARAR

Executive Order 11,990. Executive Order 11,990 requires that the destruction, loss, or degradation of wetlands be minimized and the natural and beneficial values of wetlands be enhanced in the management of Federal lands. Since RASS 3 contains a small amount of freshwater wetlands (0.68 acres), Executive Order 11,990 concerning protection of wetlands is an applicable requirement for RASS 4. The no action alternative leaves significant levels of contamination on RASS 4 and is expected to continue to have adverse impacts on the animal and vegetative populations on the RASS. In addition, the migration of contaminants from RASS 4 may adversly impact wetlands in RASS 4. Alternative 4-1 does not conform to this ARAR.

Table 7.19

Institutional Requirements Evaluation of Remedial Alternatives for RASS 3

Remedial Alternatives		Evaluation Criteria: Conformance to ARAR	Permitting Requirements	Legal Constraints	Impact on Historic and Cultural Resources	Rating
Alternative 3-1:	No Action	Low	High	Low	None	Low
Alternative 3-2:	Environmental Monitoring	Low	High	Low	None	Low
Alternative 3-3A:	Excavation/Disposal At Existing Landfills	High	High	Moderate	None	High
Alternative 3-3C:	Excavation/ Immobilization/ Disposal At Existing Landfills	High	Moderate	Moderate	None	Moderate
Alternative 3-3D:	Excavation/ Immobilization/ Disposal At Monofill on NWS Concord	High	Moderate	Moderate	None	Moderate
Alternative 3-3E:	Excavation/Soil Washing/Disposal At Existing Landfill	Moderate	Low	Moderate	None	Low
Alternative 3-3F:	Excavation/Soil Washing/Disposal At Monofill on NWS Concord	Moderate	Low	Moderate	None	Low

Table 7.20

Summary of ARAR's Analysis for RASS 4

	FCWA* (404)	FCWA* (402)	SWDA*	ESA* (7)	ESA* (9)	SDWA*	RHA*	E.O.* 11,990	E.O.* 11,988	CHSC*	CWC*	CFGC*	CPRC*
Locational													
Upland													
Waters											A	R	
Stream											R		
Wetlands	R							A	A		R		
Adjacent to Bay	R							A	A		R		
Adjacent to Stream	R							A	A		R		
Endangered Species Habitat				A	A							A	
Other Habitat													
Chemicals													
Arsenic		R	R			R				R	R	R	
Cadmium		R	R			R				R	R	R	
Copper		R	R			R				R	R	R	
Lead		R	R			R				R	R	R	
Selenium		R	R			R				R	R	R	
Zinc		R	R			R				R	R	R	
Remedial Action													
Excavation of Soil													
From Upland													
From Wetland													
From Endangered Species Habitat				A	A			A	A			A	
From Other Habitat													
Removal of Soil								A	A				A
Off-site Transport of Soil													
Off-site Disposal of Soil			A							A			
Backfilling in Wetlands	A							A	A		A	R	A
Backfilling in Uplands									A				

* FCWA = Federal Clean Water Act
SWDA = Solid Waste Disposal Act
ESA = Endangered Species Act
SDWA = Safe Drinking Water Act
RHA = Rivers & Harbors Act

E.O. = Executive Order
CHSC = California Health & Safety Code
CWC = California Water Code
CFGC = California Fish & Game Code
CPRC = California Public Resources Code

A = Applicable
R = Relevant or Appropriate
() = Operative Section

Resource Conservation and Recovery Act (RCRA). The Resource Conservation and Recovery Act regulates the treatment, storage, and disposal of hazardous wastes. Although RASS 4 is not a RCRA site, the requirements of RCRA are relevant and approprite to the concept of leaving contamination on-site. The RCRA requirements on closure and post-closure care of RCRA facilities in general, and landfills in particular, contain requirements affecting this alternative. These include requirements addressing post-closure care, property use, maintenance of site security, and monitoring (40 CFR 264 Subpart G). Alternative 4-1 does not conform to this ARAR.

The Clean Water Act. The Clean Water Act regulates the discharge of pollutants from point sources into the navigable waters of the United States. Because RASS 4 contains freshwater wetlands and streams, the requirements of the Clean Water Act are relevant and appropriate. Data collected during the RI documented the migration of contamination through the surface water pathway. Concentrations of metals in excess of ambient water quality standards were documented. Leaving the contaminants in-place will result in the continued migration of metals into the surface water. Alternative 4-1 does not conform to this ARAR.

California Water Code. The California Water Code regulates the discharge of hazardous wastes into the waters of the State. Because RASS 4 contains freshwater wetlands, the requirements of the California Water Code are relevant and appropriate. Data collected during the RI indicated that there was a discharge of hazardous waste into wetlands in the RASS 4 area. This discharge was found to be in excess of the water quality standards. Alternative 4-1 does not conform to this ARAR.

California Health and Safety Code. The California Health and Safety Code provides guidance on the identification of hazardous materials through the use of the TTLC/STLC criteria. Because the TTLC/STLC criteria provide such guidance, the TTLC/STLC criteria are relevant and appropriate. Materials exceeding these criteria have been identified on RASS 4 and would be left in place under this alternative. Alternative 4-1 does not conform to this ARAR.

The California Fish and Game Code. The California Fish and Game Code prohibits the deposition of substances or materials where such substances or

materials can pass into waters of the State of California that would have a detrimental effect on wildlife, and prohibits the taking of any endangered or threatened species of wildlife. Because contamination on RASS 4 may impact habitat for wildlife on RASS 4 and migration of contaminants from RASS 4 may impact species found on lands adjacent to RASS 4, the requirements of the California Fish and Game Code are relevant and appropriate. Data collected in the RI indicated that there was a discharge of such substances or materials into RASS 4. Alternative 4-1 does not conform to this ARAR.

Based on present understanding of the relevant facts, it is anticipated that Alternative 4-1 will be unable to attain ARAR's primarily because of the substantial quantities of contaminated materials left on RASS 4. The ARAR conformance rating for Alternative 4-1 is low.

Permitting Requirements. No permitting requirements have been identified to date for Alternative 4-1. Since no permitting requirements have been identified, the permit requirement rating of Alternative 4-1 is high.

Legal Constraints. Because contamination is left in-place, the ESA may present obstacles to the acceptance of this alternative. Therefore, the legal constraint rating for Alternative 4-1 rating is low.

Cultural Resources. No significant cultural resources would be impacted by Alternative 4-1.

Based on the evaluations presented above, the overall institutional rating for Alternative 4-1 is low.

7.3.4.2 Alternative 4-2

Conformance To ARAR

Executive Order 11,990. Executive Order 11,990 requires that the destruction, loss, or degradation of wetlands be minimized and the natural and beneficial values of wetlands be enhanced in the management of Federal lands. Since RASS 4 contains a small amount of freshwater wetlands (0.68 acres), Executive Order 11,990 concerning protection of wetlands is an applicable requirement

for RASS 4. The environmental monitoring alternative leaves significant levels of contamination on RASS 4 and is expected to continue to have adverse impacts on the animal and vegetative populations on the RASS. In addition, migration of contamination from RASS 4 may adversly impact wetlands found on RASS 4. Implementation of an extensive environmental monitoring program will aid in the identification and evaluation of adverse impacts; however, such a monitoring program will not remove existing contamination nor prevent the continued migration of contamination. Alternative 4-2 does not conform to this ARAR.

Resource Conservation and Recovery Act (RCRA). The Resource Conservation and Recovery Act regulates the treatment, storage, and disposal of hazardous wastes. Although RASS 4 is not a RCRA site per se, RCRA requirements on closure and post-closure care of RCRA facilities in general, and landfills in particular, contain requirements that are relevant and appropriate to this alternative. These include requirements addressing post-closure care, property use, maintenance of site security, and monitoring (40 CFR 264 Subpart G). Although this alternative may be designed to meet most of these concerns, the fact that significant levels of contamination will be allowed to remain on-site may raise significant RCRA concerns. Alternative 4-2 would only partially conform to this ARAR.

The Clean Water Act. The Clean Water Act regulates the discharge of pollutants from point sources into the navigable waters of the United States. Because RASS 4 contains freshwater wetlands, the requirements of the Clean Water Act are relevant and appropriate. Data collected during the RI documented the migration of contamination through the surface water pathway. Concentrations of metals in excess of ambient water quality standards were documented. Leaving the contaminants in-place will result in the continued migration of metals into the surface water. Monitoring will provide information on the migration of contaminants; however, monitoring will not prevent the continued migration of contamination. Alternative 4-2 does not conform to this ARAR.

California Water Code. The California Water Code regulates the discharge of hazardous waste into the waters of the State of California. Because RASS 4 contains freshwater wetlands and streams, the requirements of the California

Water Code are relevant and appropriate. Data collected during the RI indicated that there was a discharge of hazardous substances into the streams and wetlands in the RASS 4 area. This discharge was found to be in excess of the water quality standards. An extensive monitoring program would enable the evaluation of contaminant migration through the surface water pathway; however, it would not prevent such migration. Alternative 4-2 does not conform to this ARAR.

California Health and Safety Code. The California Health and Safety Code provides guidance on the identification of hazardous materials through the use of the TTLC/STLC criteria. Because the TTLC/STLC criteria provide such guidance, the TTLC/STLC criteria are relevant and appropriate. Materials exceeding these criteria have been identified on RASS 4 and would be left in place under this alternative. Alternative 4-2 may not conform to this ARAR.

The California Fish and Game Code. The California Fish and Game Code prohibits the deposition of substances or materials where such substances or materials can pass into waters of the State of California that would have a detrimental effect on wildlife, and prohibits the taking of any endangered or threatened species of wildlife. Because contamination left on RASS 4 would impact wildlife inhabiting RASS 4 and migration of contamination from RASS 4 would adversly impact habitat adjacent to RASS 4, the requirements of the California Fish and Game Code are relevant and appropriate. Data collected in the RI indicated that there was a discharge of such substances or materials into RASS 4. The monitoring program would provide detailed information on the environmental effects of the hazardous substances that have been discharged onto RASS 4, however, would not prevent continuation of the impacts. Alternative 4-2 would not conform to this ARAR.

Based on present understanding of the relevant facts, it is anticipated that Alternative 4-2 will be unable to attain ARAR's primarily because of the substantial quantities of contaminated materials left on RASS 4. The ARAR conformance rating of Alternative 4-2 is low.

Permitting Requirements. No permitting requirements have been identified to date for Alternative 4-2. Since no permitting requirements have been identified, the permitting requirement rating for Alternative 4-2 is high.

Legal Constraints. The ESA may present obstacles to the acceptance of this alternative. In addition, there is suspected contamination along the boundary of RASS 4 on property that is not owned by the Navy. This property will need to be included in the monitoring program; however, the Navy does not have access to the property. Therefore, the legal constraint rating for Alternative 4-2 is low.

Cultural Resources. No significant cultural resources would be impacted by Alternative 4-2.

Based on the evaluations presented above, the overall institutional rating for Alternative 4-2 is low.

7.3.4.3 Alternative 4-3A

Conformance To ARAR

Executive Order 11,990. Executive Order 11,990 requires that the destruction, loss, or degradation of wetlands be minimized and the natural and beneficial values of wetlands be enhanced in the management of Federal lands. Since RASS 4 contains a small amount of freshwater wetlands (0.68 acres), Executive Order 11,990 concerning protection of wetlands is an applicable requirement for RASS 4. Excavation activities conducted under this alternative may have a minor impact on the wetlands in the RASS. Proper design and implementation of safeguards during the construction period will limit impacts consistent with the balancing of short term and long term impacts. The extent of excavation has been limited by the selection of an active remediation area that contains the highest levels of contamination and takes into account topographic features of the site. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and the migration of such contamination. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. The potential for severe short term impacts was a factor in the development of the site specific cleanup criteria for this alternative. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 4-3A conforms to this ARAR.

Executive Order 11,988. Executive Order 11,988 requires that the natural and beneficial values of floodplains be restored and preserved in the management of Federal lands. Since RASS 4 contains a small amount of floodplains, Executive Order 11,988 is an applicable requirement for RASS 4. Excavation activities conducted in the wetlands will be affected by the requirements of Executive Order 11,988 on Floodplain Management. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and the migration of such contamination. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. The potential for severe short term impacts was a factor in the development of the site specific cleanup criteria for this alternative. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 4- 3A conforms to this ARAR.

Resource Conservation and Recovery Act (RCRA). The Resource Conservation and Recovery Act regulates the treatment, storage, and disposal of hazardous wastes. Although RASS 4 is not a RCRA site, the requirements of RCRA are relevant and approprite to the concept of leaving contamination on-site. The RCRA requirements on closure and post-closure care of RCRA facilities in general, and landfills in particular, contain requirements affecting this alternative. These include requirements addressing post-closure care, property use, maintenance of site security, and monitoring (40 CFR 264 Subpart G). Activities conducted under this alternative will be affected by the requirements of 40 CFR 261, 40 CFR 262, and 40 CFR 263. These requirements can be accomodated during the design process by ensuring that all requirements are addressed in project specifications.

Excavation and off-site transportation of contaminated materials will trigger the requirement to meet applicable Department of Transportation regulations. The transport of contaminated materials can be accomplished in accordance with such regulations. Excavation of wetland materials may trigger the RCRA ban on the landfilling of materials containing free liquids. Alternative 4-3A conforms to this ARAR.

The Clean Water Act. The Clean Water Act regulates the discharge of pollutants from point sources into the navigable waters of the United States and

regulates the discharge of dredged or fill material from point sources into the waters of the United States. Because RASS 4 contains freshwater wetlands and streams, the requirements of the Clean Water Act which regulate the discharge of pollutants into the navigable waters of the United States are relevant and appropriate and the requirements of the Clean Water Act which regulate the discharge of dredged or fill material into the waters of the United States are applicable. Data collected during the RI indicated that there was a discharge of contaminants into the streams and wetlands in the RASS 4 area. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and migration of such contamination. The extent of the reduction in contaminant migration has not been quantified. Construction activities may result in temporary increases in sediment and contaminant loads to the wetland areas of RASS 4. This possibility can be minimized through adequate design of the selected excavation method. Significant excursions above the Federal Ambient Water Quality Criteria during active remediation are not anticipated. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. Alternative 4-3A partially conforms to this ARAR.

California Water Code. The California Water Code regulates the discharge of hazardous wastes into the waters of the State of California. Because RASS 4 contains freshwater wetlands and streams, the requirements of the California Water Code are relevant and appropriate. Data collected during the RI indicated that there was a discharge of contaminants into the streams and wetlands in the RASS 4 area. This discharge was found to be in excess of the water quality standards. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and migration of such contamination. The extent of the reduction in contaminant migration has not been quantified. There is the possibility for the short term release of contamination during conduct of the remedial action; however, this potential can be minimized through adequate construction planning. The extensive monitoring program would enable the evaluation of contaminant migration through the surface water pathway and impacts on the wetlands. Alternative 4- 3A partially conforms to this ARAR.

California Health and Safety Code. The California Health and Safety Code provides guidance on the identification of hazardous materials through the use of the TTLC/STLC criteria. Because the TTLC/STLC criteria provide such guidance, the TTLC/STLC criteria are relevant and appropriate. Materials that exceed these criteria would be disposed of in accordance with appropriate regulations. All materials that exceed these criteria would be removed under this alternative. This alternative will conform to this ARAR in respect to materials disposal. Although significant quantities of contaminants are removed by this alternative, some contaminated materials would be left on site. Such materials that are left on site will be evaluated through the extensive monitoring program. Alternative 4-3A partially conforms to this ARAR.

The California Fish and Game Code. The California Fish and Game Code prohibits the deposition of substances or materials where such substances or materials can pass into waters of the State of California that would have a detrimental effect on wildlife, and prohibits the taking of any endangered or threatened species of wildlife. Because RASS 4 is a wildlife habitat, some contamination is being left on site, and construction activities would have a short term impact on the RASS, the requirements of the California Fish and Game Code are relevant and appropriate. Data collected in the RI indicated that there was a discharge of such substances or materials onto RASS 4. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and the migration of such contamination. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. Alternative 4-3A would conform to this ARAR.

Based on present understanding of the relevant facts, it is anticipated that Alternative 4-3A will be able to attain or partially attain ARAR's. In those cases where partial ARAR's conformance is attained, an environmental impacts waiver has been applied following the balancing of short and long term impacts of remediation with leaving contamination on site. The ARAR conformance rating for Alternative 4-3A is high.

Permitting Requirements. No specific permitting requirements have been identified to date for Alternative 4-3A. However, permits or coordination with appropriate agengies may be required for excavation and filling in wetlands

and transportation of contaminated materials. The permitting requirement rating for Alternative 4-3A is high.

Legal Constraints. The ESA may present obstacles to the acceptance of this alternative. Consultation with appropriate agencies during the preparation of project plans and specifications can ensure that concerns are addressed. Contamination of adjacent properties, not under Navy ownership or control, is suspected. The Navy does not have access to remediate this contamination. Therefore, the legal constraint rating for Alternative 4-3A is moderate.

Cultural Resources. No significant cultural resources would be impacted by Alternative 4-3A.

Based on the evaluations presented above, the overall institutional rating for Alternative 4-3A is high.

7.3.4.4 Alternative 4-3C

Conformance To ARAR

Executive Order 11,990. Executive Order 11,990 requires that the destruction, loss, or degradation of wetlands be minimized and the natural and beneficial values of wetlands be enhanced in the management of Federal lands. Since RASS 4 contains a small amount of freshwater wetlands (0.68 acres), Executive Order 11,990 concerning protection of wetlands is an applicable requirement for RASS 4. Excavation activities conducted under this alternative may have a minor impact on the wetlands in the RASS. Proper design and implementation of safeguards during the construction period will limit impacts consistent with the balancing of short term and long term impacts. The extent of excavation has been limited by the selection of an active remediation area that contains the highest levels of contamination and takes into account topographic features of the site. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and the migration of such contamination. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site.

The potential for severe short term impacts was a factor in the development of the site specific cleanup criteria for this alternative. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 4-3C conforms to this ARAR.

Executive Order 11,988. Executive Order 11,988 requires that the natural and beneficial values of floodplains be restored and preserved in the management of Federal lands. Since RASS 4 contains a small amount of floodplains, Executive Order 11,988 is an applicable requirement for RASS 4. Excavation activities conducted in the wetlands will be affected by the requirements of Executive Order 11,988 on Floodplain Management. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and the migration of such contamination. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. The potential for severe short term impacts was a factor in the development of the site specific cleanup criteria for this alternative. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 4-3C would conform to this ARAR.

Resource Conservation and Recovery Act (RCRA). The Resource Conservation and Recovery Act regulates the treatment, storage, and disposal of hazardous wastes. Although RASS 4 is not a RCRA site, the requirements of RCRA are relevant and approprite to the concept of leaving contamination on-site. The RCRA requirements on closure and post-closure care of RCRA facilities in general, and landfills in particular, contain requirements affecting this alternative. These include requirements addressing post-closure care, property use, maintenance of site security, and monitoring (40 CFR 264 Subpart G).

The purpose of the on-site stabilization/solidification plant is to immobilize certain metals in the contaminated soils and sediments. Therefore, the regulations governing owners and operators of hazardous waste treatment facilities would be relevant and appropriate. Activities conducted under this alternative will be affected by the requirements of 40 CFR 261, 40 CFR 262, 40 CFR 263, and 40 CFR 264. These requirements can be accomodated during the design

process by ensuring that all requirements are addressed in project specifications.

Alternative 4-3C would conform to this ARAR.

The Clean Water Act. The Clean Water Act regulates the discharge of pollutants from point sources into the navigable waters of the United States and regulates the discharge of dredged or fill material from point sources into the waters of the United States. Because RASS 4 contains freshwater wetlands and streams, the requirements of the Clean Water Act which regulate the discharge of pollutants into the navigable waters of the United States are relevant and appropriate and the requirements of the Clean Water Act which regulate the discharge of dredged or fill material into the waters of the United States are applicable. Data collected during the RI indicated that there was a discharge of contaminants into the streams and wetlands in the RASS 4 area. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and migration of such contamination. The extent of the reduction in contaminant migration has not been quantified. Construction activities may result in temporary increases in sediment loads to the wetland areas of RASS 4. This possibility can be minimized through adequate design of the selected excavation method. Significant excursions above the Federal Water Quality Criteria during active remediation are not anticipated. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. Alternative 4-3C partially conforms to this ARAR.

California Water Code. The California Water Code regulates the discharge of hazardous wastes into the waters of the State of California. Because RASS 4 contains freshwater wetlands and streams, the requirements of the California Water Code are relevant and appropriate. Data collected during the RI indicated that there was a discharge of contaminants into the streams and wetlands in the RASS 4 area. This discharge was found to be in excess of the water quality standards. The partial removal of contamination proposed by the remedial action involved in this alternative would reduce the amount of contamination on site and migration of such contamination. The extent of the reduction in contaminant reduction has not been quantified. There is the

possibility for the short term release of contamination during conduct of the remedial action; however, this potential can be reduced through adequate construction planning. The extensive monitoring program would enable the evaluation of contaminant migration through the surface water pathway and impacts on the wetlands. Alternative 4-3C partially conforms to this ARAR.

California Health and Safety Code. The California Health and Safety Code provides guidance on the identification of hazardous materials through the use of the TTLC/STLC criteria. Because the TTLC/STLC criteria provide such guidance, the TTLC/STLC criteria are relevant and appropriate. All materials that exceed these criteria will be removed from RASS 4. Materials that exceed these criteria would be disposed of in accordance with appropriate regulations. The California Health and Safety Code also affects the treatment and disposal of materials excavated from the RASS. This alternative will conform to this ARAR in respect to materials disposal. Contaminated materials that are left on-site will be evaluated through the extensive monitoring program. Alternative 4-3C partially conforms to this ARAR.

The California Fish and Game Code. The California Fish and Game Code prohibits the deposition of substances or materials where such substances or materials can pass into waters of the State of California that would have a detrimental effect on wildlife, and prohibits the taking of any endangered or threatened species of wildlife. Because RASS 4 is a wildlife habitat, some contamination is being left on site, and construction activities would have a short term impact on the RASS, the requirements of the California Fish and Game Code are relevant and appropriate. Data collected in the RI indicated that there was a discharge of such substances or materials onto RASS 4. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and the migration of such contamination. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. Although some contamination will be left on-site, Alternative 4-3C would conform to this ARAR.

Based on present understanding of the relevant facts, it is anticipated that Alternative 4-3C will be able to attain or partially attain ARAR's. In those cases where partial ARAR's conformance is attained, an environmental impacts

waiver has been applied following the balancing of short and long term impacts of remediation with leaving contamination on site. The ARAR conformance rating of Alternative 4-3C is high.

Permitting Requirements. To date, no specific permitting requirements have been identified for Alternative 4-3C. However, permits or coordination with appropriate agengies may be required for excavation and filling in wetlands and transportation of contaminated materials. The possibility exists that a permit may be required for the contaminated soil treatment facility. The permitting requirement rating for Alternative 4-3C is moderate.

Legal Constraints. The ESA may present obstacles to the acceptance of this alternative. Consultation with appropriate agencies during the preparation of project plans and specifications can ensure that concerns are addressed. Contamination of adjacent properties, not under Navy ownership or control is suspected. The Navy does not have access to remediate this contamination. Therefore, the legal constraint rating for Alternative 4-3C is moderate.

Cultural Resources. No significant cultural resources wwould be impacted by Alternative 4-3C.

Based on the evaluations presented above, the overall institutional rating for Alternative 4-3C is moderate.

7.3.4.6 Alternative 4-3D

Conformance To ARAR

Executive Order 11,990. Executive Order 11,990 requires that the destruction, loss, or degradation of wetlands be minimized and the natural and beneficial values of wetlands be enhanced in the management of Federal lands. RASS 4 contains a small amount of freshwater wetlands (0.68 acres). Excavation activities conducted under this alternative may have a minor impact on the wetlands in the RASS. Proper design and implementation of safeguards during the construction period will limit impacts consistent with the balancing of short term and long term impacts. The extent of excavation has been limited by the selection of an active remediation area that contains the highest

levels of contamination and takes into account topographic features of the site. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and the migration of such contamination. The monitoring program would provide detailed information on the envoronmental effects of the remedial action and the contaminants left on-site. The potential for severe short term impacts was a factor in the development of the site specific cleanup criteria for this alternative. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 4-3D conforms to this ARAR.

Executive Order 11,988. Executive Order 11,988 requires that the natural and beneficial values of floodplains be restored and preserved in the management of Federal lands. Since RASS 4 contains a small amount of floodplains, Executive Order 11,988 is an applicable requirement for RASS 4. Excavation activities conducted in the wetlands will be affected by the requirements of Executive Order 11,988 on Floodplain Management. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and the migration of such contamination. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. The potential for severe short term impacts was a factor in the development of the site specific cleanup criteria for this alternative. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 4-3D conforms to this ARAR.

Resource Conservation and Recovery Act (RCRA). The Resource Conservation and Recovery Act regulates the treatment, storage, and disposal of hazardous wastes. Although RASS 4 is not a RCRA site, the requirements of RCRA are relevant and approprite to the concept of leaving contamination on-site. The RCRA requirements on closure and post-closure care of RCRA facilities in general, and landfills in particular, contain requirements affecting this alternative. These include requirements addressing post-closure care, property use, maintenance of site security, and monitoring (40 CFR 264 Subpart G).

In addition, activities conducted under this alternative including operation of the stabilization/solidification facility and the siting and construction of the monofill will be affected by the requirements of 40 CFR 261, 40 CFR 262, 40 CFR 263, and 40 CFR 264. These requirements can be accomodated during the design process by ensuring that all requirements are addressed in project specifications. Excavation of wetland materials may trigger the RCRA ban on the landfilling of materials containing free liquids. Alternative 4-3D conforms to this alternative.

The Clean Water Act. The Clean Water Act regulates the discharge of pollutants from point sources into the navigable waters of the United States and regulates the discharge of dredged or fill material from point sources into the waters of the United States. Because RASS 4 contains freshwater wetlands and streams, the requirements of the Clean Water Act which regulate the discharge of pollutants into the navigable waters of the United States are relevant and appropriate and the requirements of the Clean Water Act which regulate the discharge of dredged or fill material into the waters of the United States are applicable. Data collected during the RI indicated that there was a discharge of contaminants into the streams and wetlands in the RASS 4 area. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and migration of such contamination. The extent of the reduction in contaminant migration has not been quantified. Construction activities may result in temporary increases in sediment loads to the wetland areas of RASS 4. This possibility can be minimized through adequate design of the selected excavation method. Significant excursions above the Federal Water Quality Criteria during active remediation are not anticipated. Filling, after excavation, will result in substantial short term impacts to the wetlands. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. Alternative 4-3D partially conforms to this ARAR.

California Water Code. The California Water Code regulates the discharge of contaminants into the waters of the State of California. Because RASS 4 contains freshwater wetlands and streams, the requirements of the California Water Code are relevant and appropriate. Data collected during the RI

indicated that there was a discharge of contaminants into the streams and wetlands in the RASS 4 area. This discharge was found to be in excess of the water quality standards. The partial removal of contamination by the remediation involved in this alternative would reduce the contamination on site and the migration of such contamination. The extent of the reduction in contaminant migration has not been quantified. There is the possibility for the short term release of contamination during conduct of the remedial action; however, this potential can be reduced through adequate construction planning. Filling after excavation will result in substantial short term impacts to wetlands. The extensive monitoring program would enable the evaluation of contaminant migration through the surface water pathway and impacts on wetlands. Alternative 4-3D partially conforms to this ARAR.

California Health and Safety Code. The California Health and Safety Code provides guidance on the identification of hazardous materials through the use of the TTLC/STLC criteria. Because the TTLC/STLC criteria provide such guidance, the TTLC/STLC criteria are relevant and appropriate. The State solid waste disposal facility criteria would be applicable to the location, construction, and operation of the facility. All materials that exceed these criteria would be removed from the RASS under this alternative. This alternative will conform to this ARAR in respect to materials disposal. Contaminated materials that are left on-site will be evaluated through the extensive monitoring program. Alternative 4-3D partially conforms to this ARAR.

The California Fish and Game Code. The California Fish and Game Code prohibits the deposition of substances or materials where such substances or materials can pass into waters of the State of California that would have a detrimental effect on wildlife, and prohibits the taking of any endangered or threatened species of wildlife. Because RASS 4 is a wildlife habitat, some contamination is being left on site, and construction activities would have a short term impact on the RASS, the requirements of the California Fish and Game Code are relevant and appropriate. Data collected in the RI indicated that there was a discharge of such substances or materials onto RASS 4. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and the migration of such contamination. The monitoring program would provide detailed

information on the environmental effects of the remedial action and the contaminants left on-site. Alternative 4-3D would conform to this ARAR.

Based on present understanding of the relevant facts, it is anticipated that Alternative 4-3D will be able to attain or partially attain ARAR's. In those cases where partial ARAR's conformance is attained, an environmental impacts waiver has been applied following the balancing of short and long term impacts of remediation with leaving contamination on site. The ARAR conformance rating for Alternative 4-3D is high.

Permitting Requirements. To date, no specific permitting requirements have been identified for Alternative 4-3D. However, permits or coordination with appropriate agengies may be required for excavation and filling in wetlands and transportation of contaminated materials. The possibility exists that a permit may be required for the contaminated soil treatment facility and/or the proposed monofill to be constructed on NWS Concord. The permitting requirement rating for Alternative 4-3D is moderate.

Legal Constraints. The ESA may present obstacles to the acceptance of this alternative. Consultation with appropriate agencies during the preparation of project plans and specifications can ensure that concerns are addressed. Contamination of adjacent properties, not under Navy ownership or control is suspected. The Navy does not have access to remediate this contamination. Therefore, the legal constraint rating for Alternative 4-3D is moderate.

Cultural Resources. No significant cultural resources would be impacted by Alternative 4-3D.

Based on the evaluations presented above, the overall institutional rating for Alternative 4-3D is moderate.

7.3.4.7 Alternative 4-3E

Conformance To ARAR

Executive Order 11,990. Executive Order 11,990 requires that the destruction, loss, or degradation of wetlands be minimized and the natural and beneficial values of wetlands be enhanced in the management of Federal lands. Because RASS 4 contains a small amount of freshwater wetlands (0.68 acres), Executive Order 11,990 concerning protection of wetlands is an applicable requirement for RASS 4. Excavation activities conducted under this alternative may have a minor impact on the wetlands in the RASS. Proper design and implementation of safeguards during the construction period will limit impacts consistent with the balancing of short term and long term impacts. The extent of excavation has been limited by the selection of an active remediation area that contains the highest levels of contamination and takes into account topographic features of the site. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and the migration of such contamination. The monitoring program would provide detailed information on the environmental effects of the remediation and the contaminants left on site. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 4-3E conforms to this ARAR.

Executive Order 11,988. Executive Order 11,988 requires that the natural and beneficial values of floodplains be restored and preserved in the management of Federal lands. Since RASS 4 contains a small amount of floodplains, Executive Order 11,988 is an applicable requirement for RASS 4. Excavation activities conducted in the wetlands will be affected by the requirements of Executive Order 11,988 on Floodplain Management. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and the migration of such contamination. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 4-3E conforms to this ARAR.

Resource Conservation and Recovery Act (RCRA). The Resource Conservation and Recovery Act regulates the treatment, storage, and disposal of hazardous wastes. Although RASS 4 is not a RCRA site, the requirements of RCRA are relevant and approprite to the concept of leaving contamination on-site. The

RCRA requirements on closure and post-closure care of RCRA facilities in general, and landfills in particular, contain requirements affecting this alternative. These include requirements addressing post-closure care, property use, maintenance of site security, and monitoring (40 CFR 264 Subpart G).

In addition, activities conducted under this alternative will be affected by the requirements of 40 CFR 261, 40 CFR 262, 40 CFR 263, and 40 CFR 264. These requirements can be accomodated during the design process by ensuring that all requirements are addressed in project specifications. Alternative 4-3E conforms to this ARAR.

The Clean Water Act. The Clean Water Act regulates the discharge of pollutants from point sources into the navigable waters of the United States and regulates the discharge of dredged or fill material from point sources into the waters of the United States. Because RASS 4 contains freshwater wetlands and streams, the requirements of the Clean Water Act that regulate the discharge of pollutants into the navigable waters of the United States are relevant and appropriate and the requirements of the Clean Water Act that regulate the discharge of dredged or fill material into the waters of the United States are applicable. Data collected during the RI indicated that there was a discharge of contaminants into the streams and wetlands in the RASS 4 area. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and migration of such contamination. The extent of the reduction in contaminant migration has not been quantified. Construction activities may result in temporary increases in sediment loads to the wetland areas of RASS 4. This possibility can be minimized through adequate design of the selected excavation method. Significant excursions above the Federal Water Quality Criteria during active remediation are not anticipated. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. Alternative 4-3E partially conforms to this ARAR.

California Water Code. The California Water Code regulates the discharge of hazardous wastes into the waters of the State of California. Because RASS 4 contains freshwater wetlands and streams, the requirements of the California Water Code are relevant and appropriate. Data collected during the RI

indicated that there was a discharge of contaminants into the streams and wetlands in the RASS 4 area. This discharge was found to be in excess of the water quality standards. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and migration of such contamination. The extent of the reduction in contaminant migration has not been quantified. There is the possibility for the short term release of contamination during conduct of the remedial action; however, this potential can be reduced through adequate construction planning. The extensive monitoring program would enable the evaluation of contaminant migration through the surface water pathway. Alternative 4-3E partially conforms to this ARAR.

California Health and Safety Code. The California Health and Safety Code provides guidance on the identification of hazardous materials through the use of the TTLC/STLC criteria. Because the TTLC/STLC criteria provide such guidance, the TTLC/STLC criteria are relevant and appropriate. Materials that exceed these criteria would be disposed of in accordance with appropriate regulations. All materials that exceed these criteria would be removed from the RASS under this alternative. This alternative will conform to this ARAR in respect to materials disposal. Contaminated materials that are left on-site will be evaluated through the extensive monitoring program. Alternative 1-3E partially conforms to this ARAR.

The California Fish and Game Code. The California Fish and Game Code prohibits the deposition of substances or materials where such substances or materials can pass into waters of the State of California that would have a detrimental effect on wildlife, and prohibits the taking of any endangered or threatened species of wildlife. Because RASS 4 is a wildife habitat, some contamination is being left on site, and construction activities would have a short term impact on the RASS, the requirements of the California Fish and Game Code are relevant and appropriate. Data collected in the RI indicated that there was a discharge of such substances or materials onto RASS 4. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. This alternative would conform to this ARAR. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 4-3E conforms to this ARAR.

Based on present understanding of the relevant facts, it is anticipated that Alternative 4-3E will be able to attain or partially attain ARAR's. However, because the proposed soil washing process is not a demonstrated technology for metals removal from soils, there is considerable uncertainty associated with the ability of this alternative to meet ARAR's. Therefore, the ARAR conformance rating of Alternative 4-3E is moderate.

Permitting Requirements. To date, no specific permitting requirements have been identified for Alternative 4-3E. However, permits or coordination with appropriate agengies may be required for excavation and filling in wetlands and transportation of contaminated materials. The possibility exists that a permit may be required for the contaminated soil treatment facility. Discharges from the contaminated soil treatment facility will probably require a NPDES/SPDES permit for discharge of treated waste waters. The permitting requirement rating for Alternative 4-3E is low.

Legal Constraints. The ESA may present obstacles to the acceptance of this alternative. Consultation with appropriate agencies during the preparation of project plans and specifications can ensure that concerns are addressed. Contamination of adjacent properties, not under Navy ownership or control, is suspected. The Navy does not have access to remediate this contamination. Therefore, the legal constraint rating for Alternative 4-3E is low.

Cultural Resources. No significant cultural resources would be impacted by Alternative 4-3E.

Based on the evaluations presented above, the overall institutional rating for Alternative 4-3E is low.

7.3.4.7 Alternative 4-3F

Conformance To ARAR

Executive Order 11,990. Executive Order 11,990 requires that the destruction, loss, or degradation of wetlands be minimized and the natural and beneficial values of wetlands be enhanced in the management of Federal lands. Because RASS 4 contains a small amount of freshwater wetlands (0.68 acres), Executive

Order 11,990 concerning protection of wetlands is an applicable requirement for RASS 4. Excavation activities conducted under this alternative may have minor short term impact on the wetlands in RASS 4. Proper design and implementation of safeguards during the construction period will limit impacts consistent with the balancing of short term and long term impacts. The extent of excavation has been limited by the selection of an active remediation area that contains the highest level of contamination and takes into account topographic features of the site. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and the migration of such contamination. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on site. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 4-3F conforms to this ARAR.

Executive Order 11,988. Executive Order 11,988 requires that the natural and beneficial values of floodplains be restored and preserved in the management of Federal lands. Since RASS 4 contains a small amount of floodplains, Executive Order 11,988 is an applicable requirement for RASS 4. Excavation activities conducted in the wetlands will be affected by the requirements of Executive Order 11,988 on Floodplain Management. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and the migration of such contamination. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 4-3F conforms to this ARAR.

Resource Conservation and Recovery Act (RCRA). The Resource Conservation and Recovery Act regulates the treatment, storage, and disposal of hazardous wastes. Although RASS 4 is not a RCRA site, the requirements of RCRA are relevant and approprite to the concept of leaving contamination on-site. The RCRA requirements on closure and post-closure care of RCRA facilities in general, and landfills in particular, contain requirements affecting this alternative. These include requirements addressing post-closure care, property

use, maintenance of site security, and monitoring (40 CFR 264 Subpart G).

In addition, activities conducted under this alternative will be affected by the requirements of 40 CFR 261, 40 CFR 262, 40 CFR 263, and 40 CFR 264. These requirements can be accomodated during the design process by ensuring that all requirements are addressed in project specifications. Alternative 4-3F conforms to this ARAR.

The Clean Water Act. The Clean Water Act regulates the discharge of pollutants from point sources into the navigable waters of the United States and regulates the discharge of dredged or fill material from point sources into the waters of the United States. Because RASS 4 contains freshwater wetlands and streams, the requirements of the Clean Water Act that regulate the discharge of pollutants into the navigable waters of the United States are relevant and appropriate and the requirements of the Clean Water Act that regulate the discharge of dredged or fill material into the waters of the United States are applicable. Data collected during the RI indicated that there was a discharge of contaminants into the streams and wetlands in the RASS 4 area. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and migration of such contamination. The extent of the reduction in contaminant migration has not been quantified. Construction activities may result in temporary increases in sediment loads to the wetland areas of RASS 4. This possibility can be minimized through adequate design of the selected excavation method. Significant excursions above the Federal Water Quality Criteria during active remediation are not anticipated. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. Alternative 4-3F partially conforms to this ARAR.

California Water Code. The California Water Code regulates the discharge of contaminants into the waters of the State. Because RASS 4 contains fresh water wetlands and streams, the requirements of the California Water Code are relevant and appropriate. Data collected during the RI indicated that there was a discharge of contaminants intc the streams and wetlands in the RASS 4 area. This discharge was found to be in excess of the water quality standards. The partial removal of contamination by the remedial action involved

in this alternative will reduce the amount of on site contamination and the migration of such contamination. The extent of the reduction in contaminant migration has not been quantified. There is the possibility for the short term release of contamination during conduct of the remedial action; however, this potential can be reduced through adequate construction planning. The extensive monitoring program would enable the evaluation of contaminant migration through the surface water pathway and impacts on wetlands. Alternative 4-3F partially conforms to this ARAR.

California Health and Safety Code. The California Health and Safety Code provides guidance on the identification of hazardous materials through the use of the TTLC/STLC criteria. Because the TTLC/STLC criteria provide such guidance, the TTLC/STLC criteria are relevant and appropriate. Materials that exceed these criteria would be disposed of in accordance with appropriate regulations. If a monofill is constructed for the treated soils, the State solid waste disposal facility criteria would be applicable to the location, construction, and operation of the facility. All materials that exceed these criteria would be removed under this alternative. This alternative will conform to this ARAR in respect to materials disposal. Contaminated materials left on-site will be evaluated through the extensive monitoring program. Alternative 4-3F partially conforms to this ARAR.

The California Fish and Game Code. The California Fish and Game Code prohibits the deposition of substances or materials where such substances or materials can pass into waters of the State of California that would have a detrimental effect on wildlife, and prohibits the taking of any endangered or threatened species of wildlife. Because RASS 4 is a wildlife habitat, some contamination is being left on site, and construction activities would have a short term impact on the RASS, the requirements of the California Fish and Game Code are relevant and appropriate. Data collected in the RI indicated that there was a discharge of such substances or materials onto RASS 4. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. Alternative 4-3F conform to this ARAR.

Based on present understanding of the relevant facts, it is anticipated that Alternative 4-3F will be able to attain or partially attain ARAR's. In those

cases where partial ARAR's conformance is attained, an environmental impacts waiver has been applied following the balancing of short and long term impacts of remediation with leaving contamination on site. The ARAR conformance rating of Alternative 4-3F is moderate.

Permitting Requirements. To date, no specific permitting requirements have been identified for Alternative 4-3F. However, permits or coordination with appropriate agengies may be required for excavation and filling in wetlands and transportation of contaminated materials. The possibility exists that a permit may be required for the contaminated soil treatment facility and/or the monofill proposed for construction on NWS Concord. Discharges from the contaminated soil treatment facility will probably require a NPDES/SPDES permit for discharge of treated waste waters. The permitting requirement rating for Alternative 4-3F is low.

Legal Constraints. The ESA may present obstacles to the acceptance of this alternative. Consultation with appropriate agencies during the preparation of project plans and specifications can ensure that concerns are addressed. Contamination of adjacent properties, not under Navy ownership or control, is suspected. The Navy does not have access to remediate this contamination. Therefore, the legal constraint rating for Alternative 4-3F is low.

Cultural Resources. No significant cultural resources would be impacted by this alternative.

Based on the evaluations presented above, the overall institutional rating for Alternative 4-3F is low.

7.3.4.8 Alternative 4-4A

Conformance To ARAR

Executive Order 11,990. Executive Order 11,990 requires that the destruction, loss, or degradation of wetlands be minimized and the natural and beneficial values of wetlands be enhanced in the management of Federal lands. Because RASS 4 contains a small amount of freshwater wetlands (0.68 acres), Executive Order 11,990 concerning protection of wetlands is an applicable requirement

for RASS 4. Construction activities related to construction of the soil cap and treatment of the low pH soils may have minor short term impact on the wetlands in RASS 4. Proper design and implementation of safeguards during the construction period will limit impacts consistent with the balancing of short term and long term impacts. The extent of capping has been limited by the selection of an active remediation area that contains the highest level of contamination and takes into account topographic features of the site. Isolation of the contamination by the remedial action involved in this alternative would reduce the potential for contaminant migration. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on site. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 4-4A conforms to this ARAR.

Executive Order 11,988. Executive Order 11,988 requires that the natural and beneficial values of floodplains be restored and preserved in the management of Federal lands. Since RASS 4 contains a small amount of floodplains, Executive Order 11,988 is an applicable requirement for RASS 4. Excavation activities conducted in the wetlands will be affected by the requirements of Executive Order 11,988 on Floodplain Management. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and the migration of such contamination. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 4-4A conforms to this ARAR.

Resource Conservation and Recovery Act (RCRA). The Resource Conservation and Recovery Act regulates the treatment, storage, and disposal of hazardous wastes. Although RASS 4 is not a RCRA site, the requirements of RCRA are relevant and approprite to the concept of leaving contamination on-site. The RCRA requirements on closure and post-closure care of RCRA facilities in general, and landfills in particular, contain requirements affecting this alternative. These include requirements addressing post-closure care, property use, maintenance of site security, and monitoring (40 CFR 264 Subpart G).

In addition, activities conducted under this alternative will be affected by the requirements of 40 CFR 261, 40 CFR 262, 40 CFR 263, and 40 CFR 264. These requirements can be accomodated during the design process by ensuring that all requirements are addressed in project specifications. Alternative 4-4A conforms to this ARAR.

The Clean Water Act. The Clean Water Act regulates the discharge of pollutants from point sources into the navigable waters of the United States and regulates the discharge of dredged or fill material from point sources into the waters of the United States. Because RASS 4 contains freshwater wetlands and streams, the requirements of the Clean Water Act that regulate the discharge of pollutants into the navigable waters of the United States are relevant and appropriate and the requirements of the Clean Water Act that regulate the discharge of dredged or fill material into the waters of the United States are applicable. Data collected during the RI indicated that there was a discharge of contaminants into the streams and wetlands in the RASS 4 area. The isolation of contamination by the soil cap involved in this alternative would reduce the potential for contaminant migration. The extent of the reduction in contaminant migration has not been quantified. Construction activities may result in temporary increases in sediment loads to the wetland areas of RASS 4. This possibility can be minimized through adequate design of the selected excavation method. Significant excursions above the Federal Water Quality Criteria during active remediation are not anticipated. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. Alternative 4-4A partially conforms to this ARAR.

California Water Code. The California Water Code regulates the discharge of contaminants into the waters of the State. Because RASS 4 contains fresh water wetlands and streams, the requirements of the California Water Code are relevant and appropriate. Data collected during the RI indicated that there was a discharge of contaminants into the streams and wetlands in the RASS 4 area. This discharge was found to be in excess of the water quality standards. The isolation of contamination by the soil cap involved in this alternative will reduce the potential migration of contamination. The extent of the reduction in contaminant migration has not been quantified. There is the possibility for the short term release of contamination during conduct of

the remedial action; however, this potential can be reduced through adequate construction planning. The extensive monitoring program would enable the evaluation of contaminant migration through the surface water pathway and impacts on wetlands. Alternative 4-4A partially conforms to this ARAR.

California Health and Safety Code. The California Health and Safety Code provides guidance on the identification of hazardous materials through the use of the TTLC/STLC criteria. Because the TTLC/STLC criteria provide such guidance, the TTLC/STLC criteria are relevant and appropriate. All materials that exceed these criteria would be isolated by construction of the soil cap. Contaminated materials left on-site will be evaluated through the extensive monitoring program. Alternative 4-4A partially conforms to this ARAR.

The California Fish and Game Code. The California Fish and Game Code prohibits the deposition of substances or materials where such substances or materials can pass into waters of the State of California that would have a detrimental effect on wildlife, and prohibits the taking of any endangered or threatened species of wildlife. Because RASS 4 is a wildlife habitat, and contamination is being left on site, and construction activities would have a short term impact on the RASS, the requirements of the California Fish and Game Code are relevant and appropriate. Data collected in the RI indicated that there was a discharge of such substances or materials onto RASS 4. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. Alternative 4-4A conforms to this ARAR.

Based on present understanding of the relevant facts, it is anticipated that Alternative 4-4A will be able to attain or partially attain ARAR's. In those cases where partial ARAR's conformance is attained, an environmental impacts waiver has been applied following the balancing of short and long term impacts of remediation with leaving contamination on site. The ARAR conformance rating of Alternative 4-4A is moderate.

Permitting Requirements. To date, no specific permitting requirements have been identified for Alternative 4-4A. However, permits or coordination with appropriate agengies may be required for construction of the cap. The permitting requirement rating for Alternative 4-4A is high.

Legal Constraints. No legal constraints have been identified for Alternative 4-4A. Consultation with appropriate agencies during the preparation of project plans and specifications can ensure that concerns are addressed. The legal constraint rating for Alternative 4-4A is moderate.

Cultural Resources. No significant cultural resources would be impacted by Alternative 4-4A.

Based on the evaluations presented above, the overall institutional rating for Alternative 4-4A is moderate.

7.3.4.8 Alternative 4-4B

Conformance To ARAR

Executive Order 11,990. Executive Order 11,990 requires that the destruction, loss, or degradation of wetlands be minimized and the natural and beneficial values of wetlands be enhanced in the management of Federal lands. Because RASS 4 contains a small amount of freshwater wetlands (0.68 acres), Executive Order 11,990 concerning protection of wetlands is an applicable requirement for RASS 4. Construction activities related to construction of the soil cap and treatment of the low pH soils may have minor short term impact on the wetlands in RASS 4. Proper design and implementation of safeguards during the construction period will limit impacts consistent with the balancing of short term and long term impacts. The extent of capping has been limited by the selection of an active remediation area that contains the highest level of contamination and takes into account topographic features of the site. Isolation of the contamination by the remedial action involved in this alternative would reduce the potential for contaminant migration. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on site. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 4-4B conforms to this ARAR.

Executive Order 11,988. Executive Order 11,988 requires that the natural and beneficial values of floodplains be restored and preserved in the management

of Federal lands. Since RASS 4 contains a small amount of floodplains, Executive Order 11,988 is an applicable requirement for RASS 4. Excavation activities conducted in the wetlands will be affected by the requirements of Executive Order 11,988 on Floodplain Management. The partial removal of contamination by the remedial action involved in this alternative would reduce the amount of contamination on site and the migration of such contamination. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. The area selected for active remediation results from a balancing of the short term adverse impacts with the potential for long term benefit. Alternative 4-4B conforms to this ARAR.

Resource Conservation and Recovery Act (RCRA). The Resource Conservation and Recovery Act regulates the treatment, storage, and disposal of hazardous wastes. Although RASS 4 is not a RCRA site, the requirements of RCRA are relevant and approprite to the concept of leaving contamination on-site. The RCRA requirements on closure and post-closure care of RCRA facilities in general, and landfills in particular, contain requirements affecting this alternative. These include requirements addressing post-closure care, property use, maintenance of site security, and monitoring (40 CFR 264 Subpart G).

In addition, activities conducted under this alternative will be affected by the requirements of 40 CFR 261, 40 CFR 262, 40 CFR 263, and 40 CFR 264. These requirements can be accomodated during the design process by ensuring that all requirements are addressed in project specifications. Alternative 4-4B conforms to this ARAR.

The Clean Water Act. The Clean Water Act regulates the discharge of pollutants from point sources into the navigable waters of the United States and regulates the discharge of dredged or fill material from point sources into the waters of the United States. Because RASS 4 contains freshwater wetlands and streams, the requirements of the Clean Water Act that regulate the discharge of pollutants into the navigable waters of the United States are relevant and appropriate and the requirements of the Clean Water Act that regulate the discharge of dredged or fill material into the waters of the United States are applicable. Data collected during the RI indicated that there was a discharge of contaminants into the streams and wetlands in the RASS 4 area. The

isolation of contamination by the soil cap involved in this alternative would reduce the potential for contaminant migration. The extent of the reduction in contaminant migration has not been quantified. Construction activities may result in temporary increases in sediment loads to the wetland areas of RASS 4. This possibility can be minimized through adequate design of the selected excavation method. Significant excursions above the Federal Water Quality Criteria during active remediation are not anticipated. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. Alternative 4-4B partially conforms to this ARAR.

California Water Code. The California Water Code regulates the discharge of contaminants into the waters of the State. Because RASS 4 contains fresh water wetlands and streams, the requirements of the California Water Code are relevant and appropriate. Data collected during the RI indicated that there was a discharge of contaminants into the streams and wetlands in the RASS 4 area. This discharge was found to be in excess of the water quality standards. The isolation of contamination by the soil cap involved in this alternative will reduce the potential migration of contamination. The extent of the reduction in contaminant migration has not been quantified. There is the possibility for the short term release of contamination during conduct of the remedial action; however, this potential can be reduced through adequate construction planning. The extensive monitoring program would enable the evaluation of contaminant migration through the surface water pathway and impacts on wetlands. Alternative 4-4B partially conforms to this ARAR.

California Health and Safety Code. The California Health and Safety Code provides guidance on the identification of hazardous materials through the use of the TTLC/STLC criteria. Because the TTLC/STLC criteria provide such guidance, the TTLC/STLC criteria are relevant and appropriate. All materials that exceed these criteria would be isolated by construction of the soil cap. Contaminated materials left on-site will be evaluated through the extensive monitoring program. Alternative 4-4B partially conforms to this ARAR.

The California Fish and Game Code. The California Fish and Game Code prohibits the deposition of substances or materials where such substances or materials can pass into waters of the State of California that would have a

detrimental effect on wildlife, and prohibits the taking of any endangered or threatened species of wildlife. Because RASS 4 is a wildlife habitat, and contamination is being left on site, and construction activities would have a short term impact on the RASS, the requirements of the California Fish and Game Code are relevant and appropriate. Data collected in the RI indicated that there was a discharge of such substances or materials onto RASS 4. The monitoring program would provide detailed information on the environmental effects of the remedial action and the contaminants left on-site. Alternative 4-4B conforms to this ARAR.

Based on present understanding of the relevant facts, it is anticipated that Alternative 4-4B will be able to attain or partially attain ARAR's. In those cases where partial ARAR's conformance is attained, an environmental impacts waiver has been applied following the balancing of short and long term impacts of remediation with leaving contamination on site. The ARAR conformance rating of Alternative 4-4B is moderate.

Permitting Requirements. To date, no specific permitting requirements have been identified for Alternative 4-4B. However, permits or coordination with appropriate agengies may be required for construction of the cap. The permitting requirement rating for Alternative 4-4B is high.

Legal Constraints. No legal constraints have been identified for Alternative 4-4B. Consultation with appropriate agencies during the preparation of project plans and specifications can ensure that concerns are addressed. The legal constraint rating for Alternative 4-4B is moderate.

Cultural Resources. No significant cultural resources would be impacted by Alternative 4-4B.

Based on the evaluations presented above, the overall institutional rating for Alternative 4-4B is moderate.

The institutional requirements evaluation for RASS 4 remedial action alternatives is summarized in Table 7.21.

Table 7.21

Institutional Requirements Evaluation of Remedial Alternatives for RASS 4

Remedial Alternatives		Evaluation Criteria: Conformance to ARAR	Permitting Requirements	Legal Constraints	Impact on Historic and Cultural Resources	Overall Rating
Alternative 4-1:	No Action	Low	High	Low	None	Low
Alternative 4-2:	Environmental Monitoring	Low	High	Low	None	Low
Alternative 4-3A:	Excavation/Disposal At Existing Landfills	High	High	Moderate	None	High
Alternative 4-3C:	Excavation/ Immobilization/ Disposal At Existing Landfills	High	Moderate	Moderate	None	Moderate
Alternative 4-3D:	Excavation/ Immobilization/ Disposal At Monofill on NWS Concord	High	Moderate	Moderate	None	Moderate
Alternative 4-3E:	Excavation/Soil Washing/Disposal At Existing Landfill	Moderate	Low	Low	None	Low
Alternative 4-3F:	Excavation/Soil Washing/Disposal At Monofill on NWS Concord	Moderate	Low	Low	None	Low
Alternative 4-4A:	Source Isolation/ Soil Cap	Moderate	High	Moderate	None	Moderate
Alternative 4-4B:	Source Isolation/ RCRA Cap	Moderate	High	Moderate	None	Moderate

7.4. Public Health Evaluation

7.4.1 Remedial Action Subsite 1

7.4.1.1 Alternative 1-1

Minimization of Exposure. This program would provide minimal protection of public health by only limiting landward access to the highly contaminated soils in RASS 1. This alternative will therefore only partially protect public health and is given a low rating under this evaluation criterion.

Minimization of Chemical Release. This alternative will not provide for reduction of chemical release because the contaminated soils and sediments will still be in RASS 1 and the potential for continued sediment redistribution out of this subsite remains. This alternative will therefore only partially protect public health and is given a low rating.

Release That Will Not Be Minimized. The potential exists for continued sediment migration particularly through tidal movement and, therefore, this alternative is given a low rating under this evaluation criterion.

Exposure During Remedial Action. There is only limited potential for exposure during the implementation of this remedy. Under this criterion this alternative is given a moderate rating.

Exposure After Remedial Action. Continued terrestrial and aquatic flora and fauna contact with the highly contaminated sediment is still possible. Therefore, site-specific food chain transfer of the contaminants would continue to occur in species which man may consume. In addition, the potential for direct contact with the contaminated soils will continue. Based on this evaluation criterion this alternative would be given a low rating.

Summary Rating. In summary, the public health risk reduction of this alternative would be low.

7.4.1.2 Alternative 1-2

Minimization of Exposure. The minimization of exposure would be similar to Alternative 1-1 and is therefore given a low rating under this evaluation criterion.

Minimization of Chemical Release. The minimization of chemical release exposure would be similar to Alternative 1-1 and is therefore given a low rating under this evaluation criterion.

Release That Will Not Be Minimized. The release not minimized would be similar to Alternative 1-1 and is therefore given a low rating under this evaluation criterion.

Exposure During Remedial Action. Some exposure to contaminants is expected during site monitoring activities. These can be minimized through implementation of appropriate personnel protection programs. Under this criterion this alternative is given a moderate rating.

Exposure After Remedial Action. Continued terrestrial and aquatic flora and fauna contact with the highly contaminated sediment is still possible. Therefore, site-specific food chain transfer of the contaminants would continue to occur in species which man may consume. In addition, the potential for direct contact with the contaminated soils will continue. Based on this evaluation criterion this alternative would be given a low rating.

Summary Rating. In summary, the public health risk reduction of this alternative would be low. The monitoring program will, however, provide for continued observations and study of the health impacts associated with the site specific hazards of the alternative.

7.4.1.3 Alternative 1-3A

Minimization of Exposure. This alternative would minimize the present exposure of the public through direct contact of the surface soils and sediments and through reduction in the site-specific bioaccumulation of the metal

contaminants in the area flora and fauna. This alternative is therefore rated high because it protects public health.

Minimization of Chemical Release. Because this alternative substantially removes the contaminated sediment from RASS 1 the potential for continued chemical release is minimal. Therefore, this alternative rates high under this evaluation criterion.

Releases That Will Not Be Minimized. The primary release that can be considered under this category is a moderate potential for contaminated sediment migration during excavation. In addition, because of concerns over disruption of wetland habitat, some contamination will be left in place. This alternative is given a moderate rating under this evaluation criteria.

Exposure During Remedial Action. Normal construction hazards are expected during the implementation of this alternative as well as a potential for workers to come in contact with the contaminated sediment during the excavation and transportation activities. Off-site disposal of contaminated soils necessitates transportation through populated areas. The public may be exposed to contaminants during the transportation process. Exposure to the contaminant metals is also possible if contaminated soils are stockpiled and the surface allowed to dry. Wind blown dust may be generated and exposure to the workers and nearby residents may take place. Under this evaluation criterion this alternative is rated moderate.

Exposures After Remedial Action. After remedial action is completed no significant further exposures are expected because this alternative will eliminate the present exposure of the public through the direct contact of the surface sediments and will eliminate the site specific bioaccumulation of the contaminants in aquatic flora and fauna. Based on these considerations this alternative, under this category, rates high in protection of public health.

Summary Rating. The overall rating of the public health risk reduction for this alternative is high.

7.4.1.4 Alternative 1-3C

Minimization of Exposure. The minimization of exposure to the contaminants will occur in the same manner as those detailed in Alternative 1-3A. This alternative is therefore rated high.

Minimization of Chemical Release. Future chemical releases after implementing this alternative will occur in the same way as these detailed in Alternative 1-3A. Therefore, this alternative rates high under this evaluation criterion.

Releases That Will Not Be Minimized. The releases of metal contamination post-closure will occur in the same manner as those detailed in Alternative 1-3A. This alternative is given a moderate rating under this evaluation criterion.

Exposures During Remedial Action. The same exposures to the contaminated sediment during remedial action will occur as in Alternative 1-3A but with reduced trucking hazards associated with off-site disposal of the sediments. Under this evaluation criterion this alternative is rated moderate.

Exposures After Remedial Action. Exposures to the contaminant metals after remedial action will occur in the same manner as outlined in Alternative 1-3A. Therefore, this alternative rates high under this evaluation criterion.

Summary Rating. The mitigation of the public health threat is high, as it is in Alternative 1-3A.

7.4.1.5 Alternative 1-3D

Minimization of Exposure. The minimization of exposure to the contaminants will occur in the same manner as those detailed in Alternative 1-3A. This alternative is therefore rated high.

Minimization of Chemical Release. Future chemical releases after implementing this alternative will occur in the same way as those detailed in

Alternative 1-3A. Therefore, this alternative rates high under this evaluation criterion.

Releases That Will Not Be Minimized. The releases of metal contamination post-closure will occur in the same manner as those detailed in Alternative 1-3A. This alternative is given a moderate rating under this evaluation criterion.

Exposures During Remedial Action. The same exposures to the contaminated sediment during remedial action will occur as in Alternative 1-3A but with reduced trucking hazards associated with off-site disposal of the sediments. Under this evaluation criterion this alternative is rated high.

Exposures After Remedial Action. Exposures to the contaminant metals after remedial action will occur in the same manner as outlined in Alternative 1-3A. Therefore, this alternative rates high under this evaluation criterion.

Summary Rating. The mitigation of the public health threat is high, as it is in Alternative 1-3A.

7.4.1.6 Alternative 1-3E

Minimization of Exposure. The minimization of exposure to the contaminants will occur in the same manner as those detailed in Alternative 1-3A. This alternative is therefore rated high.

Minimization of Chemical Release. Future chemical releases after implementing this alternative will occur in the same way as those detailed in Alternative 1-3A. Therefore, this alternative rates high under this evaluation criterion.

Releases That Will Not Be Minimized. The releases of metal contamination post-closure will occur in the same manner as those detailed in Alternative 1-3A. This alternative is given a moderate rating under this evaluation criterion.

Exposures During Remedial Action. The same exposures to the contaminated sediment during remedial action will occur as in Alternative 1-3A but with reduced trucking hazards associated with off-site disposal of the sediments. Under this evaluation criterion this alternative is rated moderate.

Exposures After Remedial Action. Exposures to the contaminant metals after remedial action will occur in the same manner as outlined in Alternative 1-3A. Therefore, this alternative rates high under this evaluation criterion.

Summary Rating. The mitigation of the public health threat is high, as it is in Alternative 1-3A.

7.4.1.7 Alternative 1-3F

Minimization of Exposure. The minimization of exposure to the contaminants will occur in the same manner as those detailed in Alternative 1-3A. This alternative is therefore rated high.

Minimization of Chemical Release. Future chemical releases after implementing this alternative will occur in the same way as these detailed in Alternative 1-3A. Therefore, this alternative rates high under this evaluation criterion.

Releases That Will Not Be Minimized. The releases of metal contamination post-closure will occur in the same manner as those detailed in Alternative 1-3A. This alternative is given a moderate rating under this evaluation criterion.

Exposures During Remedial Action. The same exposures to the contaminated sediment during remedial action will occur as in Alternative 1-3A but with reduced trucking hazards associated with off-site disposal of the sediments. However, contaminants will be concentrated for off-site disposal. Under this evaluation criterion this alternative is rated moderate.

Exposures After Remedial Action. Exposures to the contaminant metals after remedial action will occur in the same manner as outlined in Alternative 1-3A. Therefore, this alternative rates high under this evaluation criterion.

Summary Rating. The mitigation of the public health threat is high, as it is in Alternative 1-3A.

7.4.1.8 Summary of Public Health Evaluation for RASS 1

A summary of the public health evaluation for potential RASS 1 remedial action alternatives is presented in Table 7.22.

7.4.2 Remedial Action Subsite 2

7.4.2.1 Alternative 2-1

Minimization of Exposure. This program would provide minimal protection of public health by only limiting landward access to the highly contaminated soils in RASS 2. This alternative will therefore only partially protect public health and is given a low rating under this evaluation criterion.

Minimization of Chemical Release. This alternative will not provide for reduction of chemical release because the contaminated soils and sediments will still be in RASS 2 and the potential for continued sediment redistribution out of this subsite remains. This alternative will therefore only partially protect public health and is given a low rating.

Release That Will Not Be Minimized. The potential exists for continued sediment migration particularly through tidal movement and, therefore, this alternative is given a low rating under this evaluation criterion.

Exposure During Remedial Action. There is only limited potential for exposure during the implementation of this remedy. Under this criterion this alternative is given a moderate rating.

Table 7.22
Summary of Public Health Evaluation of Remedial Alternatives for RASS 1

Alternative	Minimization of Exposure	Minimization of Chemical Release	Release that will Not be minimized	Exposures During Remedial Action	Exposures After Remedial Action	Overall Rating
1-1: No Action	Low	Low	Low	Moderate	Low	Low
1-2: Environmental Monitoring	Low	Low	Low	Moderate	Low	Low
1-3A: Excavation/Disposal in Existing Landfills/ Restoration	High	High	Moderate	Moderate	High	High
1-3C: Excavation/Immobilization/ Disposal in Existing Landfills/Restoration	High	High	Moderate	Moderate	High	High
1-3D: Excavation/Immobilization Disposal in Monofill on NWS Concord/Restoration	High	High	Moderate	High	High	High
1-3E: Excavation/Soil Washing/ Disposal in Existing Landfills/Restoration	High	High	Moderate	Moderate	High	High
1-3F: Excavation/Soil Washing/ Disposal in Monofill on NWS Concord/Restoration	High	High	Moderate	Moderate	High	High

Exposure After Remedial Action. Continued terrestrial and aquatic flora and fauna contact with the highly contaminated sediment is still possible. Therefore, site-specific food chain transfer of the contaminants would continue to occur in species which man may consume. In addition, the potential for direct contact with the contaminated soils will continue. Based on this evaluation criterion this alternative would be given a low rating.

Summary Rating. In summary, the public health risk reduction of this alternative would be low.

7.4.2.2 Alternative 2-2

Minimization of Exposure. The minimization of exposure would be similar to Alternative 2-1 and is therefore given a low rating under this evaluation criterion.

Minimization of Chemical Release. The minimization of chemical release exposure would be similar to Alternative 2-1 and is therefore given a low rating under this evaluation criterion.

Release That Will Not Be Minimized. The release not minimized would be similar to Alternative 2-1 and is therefore given a low rating under this evaluation criterion.

Exposure During Remedial Action. Some exposure to contaminants is expected during site monitoring activities. These can be minimized through implementation of appropriate personnel protection programs. Under this criterion this alternative is given a moderate rating.

Exposure After Remedial Action. Continued terrestrial and aquatic flora and fauna contact with the highly contaminated sediment is still possible. Therefore, site-specific food chain transfer of the contaminants would continue to occur in species which man may consume. In addition, the potential for direct contact with the contaminated soils will continue. Based on this evaluation criterion this alternative would be given a low rating.

Summary Rating. In summary, the public health risk reduction of this alternative would be low. The monitoring program will, however, provide for continued observations and study of the health impacts associated with the site specific hazards of the alternative.

7.4.2.3 Alternative 2-3A

Minimization of Exposure. This alternative will eliminate the present exposure of the public through direct contact of the surface sediments and through reduction in the site-specific bioaccumulation of the metal contaminants in the area flora and fauna. This alternative is therefore rated high because it protects public health.

Minimization of Chemical Release. Because this alternative substantially removes the contaminated sediment from RASS 2 the potential for continued chemical release is minimal. Therefore, this alternative rates high under this evaluation criterion.

Releases That Will Not Be Minimized. The only release that can be considered under this category is a moderate potential for contaminated sediment migration during excavation. In addition, because of concerns over disruption of wetland habitat, some contamination will be left in place. This alternative is given a moderate rating under this evaluation criteria.

Exposure During Remedial Action. Normal construction hazards are expected during the implementation of this alternative as well as a potential for workers to come in contact with the contaminated sediment during the excavation and transportation activities. Exposure to the contaminant metals is also possible if contaminated soils are stockpiled and the surface allowed to dry. Wind blown dust may be generated and exposure to the workers and nearby residents may take place. Under this evaluation criterion this alternative is rated moderate.

Exposures After Remedial Action. After remedial action is completed no significant further exposures are expected because this alternative will eliminate the present exposure of the public through the direct contact of the

surface sediments and will eliminate the site specific bioaccumulation of the contaminants in aquatic flora and fauna. Based on these considerations this alternative, under this category, rates high in protection of public health.

Summary Rating. The overall rating of the public health risk reduction for this alternative is high.

7.4.2.4 Alternative 2-3C

Minimization of Exposure. The minimization of exposure to the contaminants will occur in the same manner as those detailed in Alternative 2-3A. This alternative is therefore rated high.

Minimization of Chemical Release. Future chemical releases after implementing this alternative will occur in the same way as these detailed in Alternative 2-3A. Therefore, this alternative rates high under this evaluation criterion.

Releases That Will Not Be Minimized. The releases of metal contamination post-closure will occur in the same manner as those detailed in Alternative 2-3A. This alternative is given a moderate rating under this evaluation criterion.

Exposures During Remedial Action. The same exposures to the contaminated sediment during remedial action will occur as in Alternative 2-3A but with reduced trucking hazards associated with off-site disposal of the sediments. Under this evaluation criterion this alternative is rated moderate.

Exposures After Remedial Action. Exposures to the contaminant metals after remedial action will occur in the same manner as outlined in Alternative 2-3A. Therefore, this alternative rates high under this evaluation criterion.

Summary Rating. The mitigation of the public health threat is high, as it is in Alternative 2-3A.

7.4.2.5 Alternative 2-3D

Minimization of Exposure. The minimization of exposure to the contaminants will occur in the same manner as those detailed in Alternative 2-3A. This alternative is therefore rated high.

Minimization of Chemical Release. Future chemical releases after implementing this alternative will occur in the same way as these detailed in Alternative 2-3A. Therefore, this alternative rates high under this evaluation criterion.

Releases That Will Not Be Minimized. The releases of metal contamination post-closure will occur in the same manner as those detailed in Alternative 2-3A. This alternative is given a moderate rating under this evaluation criterion.

Exposures During Remedial Action. The same exposures to the contaminated sediment during remedial action will occur as in Alternative 2-3A but with reduced trucking hazards associated with off-site disposal of the sediments. Under this evaluation criterion this alternative is rated high.

Exposures After Remedial Action. Exposures to the contaminant metals after remedial action will occur in the same manner as outlined in Alternative 2-3A. Therefore, this alternative rates high under this evaluation criterion.

Summary Rating. The mitigation of the public health threat is high, as it is in Alternative 2-3A.

7.4.2.6 Alternative 2-3E

Minimization of Exposure. The minimization of exposure to the contaminants will occur in the same manner as those detailed in Alternative 2-3A. This alternative is therefore rated high.

Minimization of Chemical Release. Future chemical releases after implementing this alternative will occur in the same way as those detailed in

Alternative 2-3A. Therefore, this alternative rates high under this evaluation criterion.

Releases That Will Not Be Minimized. The releases of metal contamination post-closure will occur in the same manner as those detailed in Alternative 2-3A. This alternative is given a moderate rating under this evaluation criterion.

Exposures During Remedial Action. The same exposures to the contaminated sediment during remedial action will occur as in Alternative 2-3A but with reduced trucking hazards associated with off-site disposal of the sediments. Under this evaluation criterion this alternative is rated moderate.

Exposures After Remedial Action. Exposures to the contaminant metals after remedial action will occur in the same manner as outlined in Alternative 2-3A. Therefore, this alternative rates high under this evaluation criterion.

Summary Rating. The mitigation of the public health threat is high, as it is in Alternative 2-3A.

7.4.2.7 Alternative 2-3F

Minimization of Exposure. The minimization of exposure to the contaminants will occur in the same manner as those detailed in Alternative 2-3A. This alternative is therefore rated high.

Minimization of Chemical Release. Future chemical releases after implementing this alternative will occur in the same way as those detailed in Alternative 2-3A. Therefore, this alternative rates high under this evaluation criterion.

Releases That Will Not Be Minimized. The releases of metal contamination post-closure will occur in the same manner as those detailed in Alternative 2-3A. This alternative is given a moderate rating under this evaluation criterion.

Exposures During Remedial Action. The same exposures to the contaminated sediment during remedial action will occur as in Alternative 2-3A but with reduced trucking hazards associated with off-site disposal of the sediments. Contaminants would be concentrated for off-site disposal. Under this evaluation criterion this alternative is rated moderate.

Exposures After Remedial Action. Exposures to the contaminant metals after remedial action will occur in the same manner as outlined in Alternative 2-3A. Therefore, this alternative rates high under this evaluation criterion.

Summary Rating. The mitigation of the public health threat is high, as it is in Alternative 2-3A.

7.4.2.8 Summary of Public Health Evaluation for RASS 2

A summary of the public health evaluation for potential RASS 2 remedial action alternatives is presented in Table 7.23.

7.4.3 Remedial Action Subsite 3

7.4.3.1 Alternative 3-1

Minimization of Exposure. This program would provide minimal protection of public health by only limiting landward access to the highly contaminated soils in RASS 3. This alternative will therefore only partially protect public health and is given a low rating under this evaluation criterion.

Minimization of Chemical Release. This alternative will not provide for reduction of chemical release because the contaminated soils and sediments will still be in RASS 3 and the potential for continued sediment redistribution out of this subsite remains. This alternative will therefore only partially protect public health and is given a low rating.

Release That Will Not Be Minimized. The potential exists for continued sediment migration particularly through soil movement during storm events and,

Table 7.23

Summary of Public Health Evaluation of Remedial Alternatives for RASS 2

Alternative	Minimization of Exposure	Minimization of Chemical Release	Release that will Not be minimized	Exposures During Remedial Action	Exposures After Remedial Action	Overall Rating
2-1: No Action	Low	Low	Low	Moderate	Low	Low
2-2: Environmental Monitoring	Low	Low	Low	Moderate	Low	Low
2-3A: Excavation/Disposal in Existing Landfills/ Restoration	High	High	Moderate	Moderate	High	High
2-3C: Excavation/Immobilization/ Disposal in Existing Landfills/Restoration	High	High	Moderate	Moderate	High	High
2-3D: Excavation/Immobilization Disposal in Monofill on NWS Concord/Restoration	High	High	Moderate	High	High	High
2-3E: Excavation/Soil Washing/ Disposal in Existing Landfills/Restoration	High	High	Moderate	Moderate	High	High
2-3F: Excavation/Soil Washing/ Disposal in Monofill on NWS Concord/Restoration	High	High	Moderate	Moderate	High	High

therefore, this alternative is given a low rating under this evaluation criterion.

Exposure During Remedial Action. There is only limited potential for exposure during the implementation of this remedy. Under this criterion this alternative is given a moderate rating.

Exposure After Remedial Action. Continued terrestrial and aquatic flora and fauna contact with the contaminated sediment is still possible. Therefore, site-specific food chain transfer of the contaminants would continue to occur in species which man may consume. In addition, the potential for direct contact with the contaminated soils will continue. Contaminants will also migrate into other downstream areas, i.e., RASS 1 and RASS 2. Based on this evaluation criterion this alternative would be given a low rating.

Summary Rating. In summary, the public health risk reduction of this alternative would be low.

7.4.3.2 Alternative 3-2

Minimization of Exposure. The minimization of exposure would be similar to Alternative 3-1 and is therefore given a low rating under this evaluation criterion.

Minimization of Chemical Release. The minimization of chemical release exposure would be similar to Alternative 3-1 and is therefore given a low rating under this evaluation criterion.

Release That Will Not Be Minimized. The release not minimized would be similar to Alternative 3-1 and is therefore given a low rating under this evaluation criterion.

Exposure During Remedial Action. Some exposure to contaminants is expected during site monitoring activities. These can be minimized through implementation of appropriate personnel protection programs. Under this criterion this alternative is given a moderate rating.

Exposure After Remedial Action. Continued terrestrial and aquatic flora and fauna contact with the highly contaminated sediment is still possible. Therefore, site-specific food chain transfer of the contaminants would continue to occur in species which man may consume. In addition, the potential for direct contact with the contaminated soils will continue. Contamination will continue to migrate into RASS 1 and RASS 2. Based on this evaluation criterion this alternative would be given a low rating.

Summary Rating. In summary, the public health risk reduction of this alternative would be low. The monitoring program will, however, provide for continued observations and study of the health impacts associated with the site specific hazards of the alternative.

7.4.3.3 Alternative 3-3A

Minimization of Exposure. This alternative will eliminate the present exposure of the public through direct contact of the surface sediments and through reduction in the site-specific bioaccumulation of the metal contaminants in the area flora and fauna. This alternative is therefore rated high because it protects public health.

Minimization of Chemical Release. Because this alternative substantially removes the contaminated sediment from RASS 3 the potential for continued chemical release is minimal. Therefore, this alternative rates high under this evaluation criterion.

Releases That Will Not Be Minimized. The primary release that can be considered under this category is a moderate potential for contaminated sediment migration during excavation. In addition, because of concerns over disruption of wetland habitat, some contamination will be left in place. This alternative is given a moderate rating under this evaluation criteria.

Exposure During Remedial Action. Normal construction hazards are expected during the implementation of this alternative as well as a potential for workers to come in contact with the contaminated sediment during the excavation and transportation activities. Exposure to the contaminant metals

is also possible if contaminated soils are stockpiled and the surface allowed to dry. Wind blown dust may be generated and exposure to the workers and nearby residents may take place. Under this evaluation criterion this alternative is rated moderate.

Exposures After Remedial Action. After remedial action is completed no significant further exposures are expected because this alternative will eliminate the present exposure of the public through the direct contact of the surface sediments and will eliminate the site specific bioaccumulation of the contaminants in aquatic flora and fauna. Based on these considerations this alternative, under this category, rates high in protection of public health.

Summary Rating. The overall rating of the public health risk reduction for this alternative is high.

7.4.3.4 Alternative 3-3C

Minimization of Exposure. The minimization of exposure to the contaminants will occur in the same manner as those detailed in Alternative 3-3A. This alternative is therefore rated high.

Minimization of Chemical Release. Future chemical releases after implementing this alternative will occur in the same way as these detailed in Alternative 3-3A. Therefore, this alternative rates high under this evaluation criterion.

Releases That Will Not Be Minimized. The releases of metal contamination post-closure will occur in the same manner as those detailed in Alternative 3-3A. This alternative is given a moderate rating under this evaluation criterion.

Exposures During Remedial Action. The same exposures to the contaminated sediment during remedial action will occur as in Alternative 3-3A but with reduced trucking hazards associated with off-site disposal of the sediments. Under this evaluation criterion this alternative is rated moderate.

Exposures After Remedial Action. Exposures to the contaminant metals after remedial action will occur in the same manner as outlined in Alternative 3-3A. Therefore, this alternative rates high under this evaluation criterion.

Summary Rating. The mitigation of the public health threat is high, as it is in Alternative 3-3A.

7.4.3.5 Alternative 3-3D

Minimization of Exposure. The minimization of exposure to the contaminants will occur in the same manner as those detailed in Alternative 3-3A. This alternative is therefore rated high.

Minimization of Chemical Release. Future chemical releases after implementing this alternative will occur in the same way as those detailed in Alternative 3-3A. Therefore, this alternative rates high under this evaluation criterion.

Releases That Will Not Be Minimized. The releases of metal contamination post-closure will occur in the same manner as those detailed in Alternative 3-3A. This alternative is given a moderate rating under this evaluation criterion.

Exposures During Remedial Action. The same exposures to the contaminated sediment during remedial action will occur as in Alternative 3-3A but with reduced trucking hazards associated with off-site disposal of the sediments. Under this evaluation criterion this alternative is rated high.

Exposures After Remedial Action. Exposures to the contaminant metals after remedial action will occur in the same manner as outlined in Alternative 3-3A. Therefore, this alternative rates high under this evaluation criterion.

Summary Rating. The mitigation of the public health threat is high, as it is in Alternative 3-3A.

7.4.3.6 Alternative 3-3E

Minimization of Exposure. The minimization of exposure to the contaminants will occur in the same manner as those detailed in Alternative 3-3A. This alternative is therefore rated high.

Minimization of Chemical Release. Future chemical releases after implementing this alternative will occur in the same way as those detailed in Alternative 3-3A. Therefore, this alternative rates high under this evaluation criterion.

Releases That Will Not Be Minimized. The releases of metal contamination post-closure will occur in the same manner as those detailed in Alternative 3-3A. This alternative is given a moderate rating under this evaluation criterion.

Exposures During Remedial Action. The same exposures to the contaminated sediment during remedial action will occur as in Alternative 3-3A but with reduced trucking hazards associated with off-site disposal of the sediments. Under this evaluation criterion this alternative is rated moderate.

Exposures After Remedial Action. Exposures to the contaminant metals after remedial action will occur in the same manner as outlined in Alternative 3-3A. Therefore, this alternative rates high under this evaluation criterion.

Summary Rating. The mitigation of the public health threat is high, as it is in Alternative 3-3A.

7.4.3.7 Alternative 3-3F

Minimization of Exposure. The minimization of exposure to the contaminants will occur in the same manner as those detailed in Alternative 3-3A. This alternative is therefore rated high.

Minimization of Chemical Release. Future chemical releases after implementing this alternative will occur in the same way as these detailed in

Alternative 3-3A. Therefore, this alternative rates high under this evaluation criterion.

Releases That Will Not Be Minimized. The releases of metal contamination post-closure will occur in the same manner as those detailed in Alternative 3-3A. This alternative is given a moderate rating under this evaluation criterion.

Exposures During Remedial Action. The same exposures to the contaminated sediment during remedial action will occur as in Alternative 3-3A but with reduced trucking hazards associated with off-site disposal of the sediments. Under this evaluation criterion this alternative is rated moderate.

Exposures After Remedial Action. Exposures to the contaminant metals after remedial action will occur in the same manner as outlined in Alternative 3-3A. Therefore, this alternative rates high under this evaluation criterion.

Summary Rating. The mitigation of the public health threat is high, as it is in Alternative 3-3A.

7.4.3.8 Summary of Public Health Evaluation for RASS 3

A summary of the public health evaluation for potential RASS 3 remedial action alternatives is presented in Table 7.24.

7.4.4 Remedial Action Subsite 4

7.4.4.1 Alternative 4-1

Minimization of Exposure. This program would provide minimal protection of public health by only limiting access to the highly contaminated soils in RASS 4. This alternative will therefore only partially protect public health and is given a low rating under this evaluation criterion.

Minimization of Chemical Release. This alternative will not provide for reduction of chemical release because the contaminated soils will still be in

Table 7.24

Summary of Public Health Evaluation of Remedial Alternatives for RASS 3

Alternative		Minimization of Exposure	Minimization of Chemical Release	Release that will Not be minimized	Exposures During Remedial Action	Exposures After Remedial Action	Overall Rating
3-1:	No Action	Low	Low	Low	Moderate	Low	Low
3-2:	Environmental Monitoring	Low	Low	Low	Moderate	Low	Low
3-3A:	Excavation/Disposal in Existing Landfills	High	High	Moderate	Moderate	High	High
3-3C:	Excavation/Immobilization/ Disposal At Existing Landfills	High	High	Moderate	Moderate	High	High
3-3D:	Excavation/Immobilization/ Disposal At Monofill on NWS Concord	High	High	Moderate	High	High	High
3-3E:	Excavation/Soil Washing/ Disposal At Existing Landfill	High	High	Moderate	Moderate	High	High
3-3F:	Excavation/Soil Washing/ Disposal At Monofill on NWS Concord	High	High	Moderate	Moderate	High	High

RASS 4 and the potential for continued redistribution of contaminants on and off this subsite remains. This alternative will therefore only partially protect public health and is given a low rating.

Release That Will Not Be Minimized. The potential exists for continued contaminant migration particularly soil movement during storm events. This alternative is given a low rating under this evaluation criterion.

Exposure During Remedial Action. There is only limited potential for exposure during the implementation of this remedy. Under this criterion this alternative is given a moderate rating.

Exposure After Remedial Action. Continued terrestrial flora and fauna contact with the highly contaminated soils is still possible. Therefore, site-specific food chain transfer of the contaminants would continue to occur in species which man may consume. In addition, the potential for direct contact with the contaminated soils will continue. Based on this evaluation criterion this alternative is given a low rating.

Summary Rating. In summary, the public health risk reduction of this alternative would be low.

7.4.4.2 Alternative 4-2

Minimization of Exposure. The minimization of exposure would be similar to Alternative 4-1 and is therefore given a low rating under this evaluation criterion.

Minimization of Chemical Release. The minimization of chemical release exposure would be similar to Alternative 4-1 and is therefore given a low rating under this evaluation criterion.

Release That Will Not Be Minimized. The release not minimized would be similar to Alternative 4-1 and is therefore given a low rating under this evaluation criterion.

Exposure During Remedial Action. Some exposure to contaminants is expected during site monitoring activities. These can be minimized through implementation of appropriate personnel protection programs. Under this criterion this alternative is given a moderate rating.

Exposure After Remedial Action. Continued terrestrial flora and fauna contact with the highly contaminated sediment is still possible. Therefore, site-specific food chain transfer of the contaminants would continue to occur in species which man may consume. In addition, the potential for direct contact with the contaminated soils will continue. Based on this evaluation criterion this alternative would be given a low rating.

Summary Rating. In summary, the public health risk reduction of this alternative would be low. The monitoring program will, however, provide for continued observations and study of the health impacts associated with the site specific hazards of the alternative.

7.4.4.3 Alternative 4-3A

Minimization of Exposure. This alternative will eliminate the present exposure of the public through direct contact of the surface soils and through reduction in the site-specific bioaccumulation of the metal contaminants in the area flora and fauna. This alternative is therefore rated high because it protects public health.

Minimization of Chemical Release. Because this alternative substantially removes the contaminated sediment from RASS 4 the potential for continued chemical release is minimal. Therefore, this alternative rates high under this evaluation criterion.

Releases That Will Not Be Minimized. The only release that can be considered under this category is a moderate potential for contaminated soil migration during excavation. This alternative is given a moderate rating under this evaluation criteria.

Exposure During Remedial Action. Normal construction hazards are expected during the implementation of this alternative as well as a potential for workers to come in contact with the contaminated sediment during the excavation and transportation activities. Exposure to the contaminant metals is also possible if contaminated soils are stockpiled and the surface allowed to dry. Wind blown dust may be generated and exposure to the workers and nearby residents may take place. Under this evaluation criterion this alternative is rated moderate.

Exposures After Remedial Action. After remedial action is completed no significant further exposures are expected because this alternative will eliminate the present exposure of the public through the direct contact of the surface sediments and will eliminate the site specific bioaccumulation of the contaminants in aquatic flora and fauna. Based on these considerations this alternative, under this category, rates high in protection of public health.

Summary Rating. The overall rating of the public health risk reduction for this alternative is high.

7.4.4.4 Alternative 4-3C

Minimization of Exposure. The minimization of exposure to the contaminants will occur in the same manner as those detailed in Alternative 4-3A. This alternative is therefore rated high.

Minimization of Chemical Release. Future chemical releases after implementing this alternative will occur in the same way as these detailed in Alternative 4-3A. Therefore, this alternative rates high under this evaluation criterion.

Releases That Will Not Be Minimized. The releases of metal contamination post-closure will occur in the same manner as those detailed in Alternative 4-3A. This alternative is given a moderate rating under this evaluation criterion.

Exposures During Remedial Action. The same exposures to the contaminated sediment during remedial action will occur as in Alternative 4-3A but with reduced trucking hazards associated with off-site disposal of the sediments. Under this evaluation criterion this alternative is rated moderate.

Exposures After Remedial Action. Exposures to the contaminant metals after remedial action will occur in the same manner as outlined in Alternative 4-3A. Therefore, this alternative rates high under this evaluation criterion.

Summary Rating. The mitigation of the public health threat is high, as it is in Alternative 4-3A.

7.4.4.5 Alternative 4-3D

Minimization of Exposure. The minimization of exposure to the contaminants will occur in the same manner as those detailed in Alternative 4-3A. This alternative is therefore rated high.

Minimization of Chemical Release. Future chemical releases after implementing this alternative will occur in the same way as these detailed in Alternative 4-3A. Therefore, this alternative rates high under this evaluation criterion.

Releases That Will Not Be Minimized. The releases of metal contamination post-closure will occur in the same manner as those detailed in Alternative 4-3A. This alternative is given a moderate rating under this evaluation criterion.

Exposures During Remedial Action. The same exposures to the contaminated sediment during remedial action will occur as in Alternative 4-3A but with reduced trucking hazards associated with off-site disposal of the sediments. Under this evaluation criterion this alternative is rated high.

Exposures After Remedial Action. Exposures to the contaminant metals after remedial action will occur in the same manner as outlined in Alternative 4-3A. Therefore, this alternative rates high under this evaluation criterion.

Summary Rating. The mitigation of the public health threat is high, as it is in Alternative 4-3A.

7.4.4.6 Alternative 4-3E

Minimization of Exposure. The minimization of exposure to the contaminants will occur in the same manner as those detailed in Alternative 4-3A. This alternative is therefore rated high.

Minimization of Chemical Release. Future chemical releases after implementing this alternative will occur in the same way as these detailed in Alternative 4-3A. Therefore, this alternative rates high under this evaluation criterion.

Releases That Will Not Be Minimized. The releases of metal contamination post-closure will occur in the same manner as those detailed in Alternative 4-3A. This alternative is given a moderate rating under this evaluation criterion.

Exposures During Remedial Action. The same exposures to the contaminated sediment during remedial action will occur as in Alternative 4-3A but with reduced trucking hazards associated with off-site disposal of the sediments. Under this evaluation criterion this alternative is rated moderate.

Exposures After Remedial Action. Exposures to the contaminant metals after remedial action will occur in the same manner as outlined in Alternative 4-3A. Therefore, this alternative rates high under this evaluation criterion.

Summary Rating. The mitigation of the public health threat is high, as it is in Alternative 4-3A.

7.4.4.7 Alternative 4-3F

Minimization of Exposure. The minimization of exposure to the contaminants will occur in the same manner as those detailed in Alternative 4-3A. This alternative is therefore rated high.

Minimization of Chemical Release. Future chemical releases after implementing this alternative will occur in the same way as these detailed in Alternative 4-3A. Therefore, this alternative rates high under this evaluation criterion.

Releases That Will Not Be Minimized. The releases of metal contamination post-closure will occur in the same manner as those detailed in Alternative 4-3A. This alternative is given a moderate rating under this evaluation criterion.

Exposures During Remedial Action. The same exposures to the contaminated sediment during remedial action will occur as in Alternative 4-3A but with reduced trucking hazards associated with off-site disposal of the sediments. Contaminants would be concentrated and transported off-site. Under this evaluation criterion this alternative is rated moderate.

Exposures After Remedial Action. Exposures to the contaminant metals after remedial action will occur in the same manner as outlined in Alternative 4-3A. Therefore, this alternative rates high under this evaluation criterion.

Summary Rating. The mitigation of the public health threat is high, as it is in Alternative 4-3A.

7.4.4.8 Alternative 4-4A

Minimization of Exposure. This alternative will eliminate the present exposure of the public through direct contact of the surface sediments and through reduction in the site-specific bioaccumulation of the metal contaminants in the area flora and fauna. This alternative is therefore rated high because it protects public health.

Minimization of Chemical Release. Overall, this alternative reduces the potential for contaminant migration from RASS 4. Therefore, this alternative rates high under this evaluation criterion.

Releases That Will Not Be Minimized. The only release that can be considered under this category is a moderate potential for contaminated soils migration during construction. Contamination will be left in place, however, a well maintained cap should prevent further releases. This alternative is given a moderate rating under this evaluation criteria.

Exposure During Remedial Action. Normal construction hazards are expected during the implementation of this alternative as well as a potential for workers to come in contact with the contaminated sediment during the construction of the cap. Wind blown dust may be generated and exposure to the workers and nearby residents may take place. Under this evaluation criterion this alternative is rated moderate.

Exposures After Remedial Action. After remedial action is completed no significant further exposures are expected because this alternative will eliminate the present exposure of the public through the direct contact of the surface soils and will eliminate the site specific bioaccumulation of the contaminants in aquatic flora and fauna. Based on these considerations this alternative, under this category, rates high in protection of public health.

Summary Rating. The overall rating of the public health risk reduction for this alternative is high.

7.4.4.9 Alternative 4-4B

Minimization of Exposure. This alternative will eliminate the present exposure of the public through direct contact of the surface sediments and through reduction in the site-specific bioaccumulation of the metal contaminants in the area flora and fauna. This alternative is therefore rated high because it protects public health.

Minimization of Chemical Release. Overall, this alternative reduces the potential for contaminant migration from RASS 4. Therefore, this alternative rates high under this evaluation criterion.

Releases That Will Not Be Minimized. The only release that can be considered under this category is a moderate potential for contaminated sediment migration during construction. Some contamination will be left in place, however, a well maintained cap should prevent further releases. This alternative is given a moderate rating under this evaluation criteria.

Exposure During Remedial Action. Normal construction hazards are expected during the implementation of this alternative as well as a potential for workers to come in contact with the contaminated sediment during the construction of the cap. Wind blown dust may be generated and exposure to the workers and nearby residents may take place. Under this evaluation criterion this alternative is rated moderate.

Exposures After Remedial Action. After remedial action is completed no significant further exposures are expected because this alternative will eliminate the present exposure of the public through the direct contact of the surface sediments and will eliminate the site specific bioaccumulation of the contaminants in aquatic flora and fauna. Based on these considerations this alternative, under this category, rates high in protection of public health.

Summary Rating. The overall rating of the public health risk reduction for this alternative is high.

7.4.4.10 Summary of Public Health Evaluation for RASS 4

A summary of the public health evaluation for potential RASS 4 remedial action alternatives is presented in Table 7.25.

7.5 Cost Analysis

The detailed cost analysis consists of three steps: estimation of capital and annual operating costs, present worth analysis, and sensitivity analysis (USEPA 1985). The development of the conceptual level cost estimates are based on the alternatives presented in section 7.

Table 7.25

Summary of Public Health Evaluation of Remedial Alternatives for RASS 4

Alternative	Minimization of Exposure	Minimization of Chemical Release	Release that will Not be minimized	Exposures During Remedial Action	Exposures After Remedial Action	Overall Rating
4-1: No Action	Low	Low	Low	Moderate	Low	Low
4-2: Environmental Monitoring	Low	Low	Low	Moderate	Low	Low
4-3A: Excavation/Off-Site Disposal	High	High	Moderate	Moderate	High	High
4-3C: Excavation/Immobilization/ Disposal in Existing Landfills	High	High	Moderate	Moderate	High	High
4-3D: Excavation/Immobilization/ Disposal in Monofill on NWS Concord	High	High	Moderate	High	High	High
4-3E: Excavation/Soil Washing/ Disposal in Existing Landfills	High	High	Moderate	Moderate	High	High
4-3F: Excavation/Soil Washing/ Disposal in Monofill on NWS Concord	High	High	Moderate	Moderate	High	High
4-4A: Source Isolation/Soil Cap	High	High	Moderate	Moderate	High	High
4-4B: Source Isolation/RCRA Cap	High	High	Moderate	Moderate	High	High

Capital costs were generated by identifying all important facilities, equipment, and construction features associated with each alternative. These major items were quantified (Appendix A) and used in conjunction with the unit costs presented in Table 7.26 to estimate the costs of each remedial alternative.

The cost estimates presented in this section are based on an estimate of first quarter 1988 costs in the San Francisco Bay area. The costs include contractor profit and overhead. In addition, the following assumptions have been made.

a. All required utilities will be readily available at the site.

b. Access to the site will be available.

c. Sufficient qualified labor is available.

d. Construction will be conducted in a normal fashion, i.e., 40 hour work week, no scheduled shift work, and a twelve month construction year.

e. Additional land will be available, if required.

f. Taxes (local, state, and federal), purchase of heavy equipment, and environmental permitting fees are excluded, except for an assumed disposal tax/fee.

g. A contingency factor of 25 percent is added to all construction costs.

h. Engineering and design, testing and services during construction are included as an add on 15 percent.

i. Mobilization/demobilization are added at the rate of 10 percent of construction costs.

j. Disposal in existing cost based on truck transport to a California disposal site.

Operation and maintenance costs were developed for each remedial alternative. Operation and maintenance costs are assumed to last 30 years unless otherwise noted. An administrative cost is also included in the operation and maintenance costs. This cost accommodates the cost of contracting for required services.

Present worth analysis is used to evaluate the capital and operation and maintenance costs that occur over different time periods of the remedial

Table 7.26

Summary of Unit Costs

Item Description	Unit of Measure	Unit Cost($)
Dry Excavation (Class I)	CY	5.00
Wet Excavation (Class I)	CY	10.00
Dry Excavation	CY	4.00
Wet Excavation	CY	8.00
Site Grading	SY	1.00
Site Revegetation	SY	1.00
Backfilling with Clean Soil	CY	23.00
Natural Soil Liner/Soil Cap	SY	15.00
Natural Soil Liner/Cap Plus FML	SY	39.00
Top Soil Cover	CY	28.00
Class I Transportation (Truck to California Site)	CY(loose)	50.00
Class I Transportation (Rail to Utah)	CY(loose)	87.00
Class II Transportation (Truck to California Site)	CY(loose)	144.00
Class III Transportation (Truck to California Site)	CY(loose)	15.00
Class III Transportation (Truck to Site on NWS Concord)	CY(loose)	10.00
Class I Disposal (RCRA-California Site)	CY(loose)	239.00
Class I Disposal (Non-RCRA-California Site)	CY(loose)	157.00
Class I Disposal (RCRA-Utah Site)	CY(loose)	179.00
Class I Disposal (Non-RCRA-Utah Site)	CY(loose)	100.00
Class II Disposal (Existing Landfill)	CY(loose)	124.00
Class III Disposal (Existing Landfill)	CY(loose)	20.00
Class I Disposal (Monofill Construction)	CY(loose)	30.00
Class II Disposal (Monofill Construction)	CY(loose)	24.00
Class III Disposal (Monofill Construction)	CY(loose)	18.00
Fencing	LF	11.00
Wetland Restoration	SY	3.00
Solidification/Stabilization of Contaminated Soil	CY(loose)	46.00
Soil Washing	CY(bank)	200.00

alternatives by discounting all future costs to present worth. This allows the comparison of alternatives on the basis of a single total cost figure representing the amount of money, that, if invested in the base year and expended as needed, would be sufficient to cover all costs associated with implementation of the remedial action. The present worth is a function of the discount rate and the time period. A discount rate of 10 percent and time period of 30 years are selected for the initial present worth analysis (USEPA 1985).

7.5.1 Presentation of Costs

7.5.1.1 Remedial Action Subsite 1. An itemized breakdown of the capital cost for all alternatives is presented in Appendix B. An itemized breakout of operation and maintenance costs is presented in Appendix C. Table 7.27 presents a summary of the capital, present worth of the operation and maintenance cost, and total present worth cost of each alternative.

7.5.1.2 Remedial Action Subsite 2. An itemized breakdown of the capital cost for all alternatives is presented in Appendix B. An itemized breakout of operation and maintenance costs is presented in Appendix C. Table 7.28 presents a summary of the capital, present worth of the operation and maintenance cost, and total present worth cost of each alternative.

7.5.1.3 Remedial Action Subsite 3. An itemized breakdown of the capital cost for all alternatives is presented in Appendix B. An itemized breakout of operation and maintenance costs is presented in Appendix C. Table 7.29 presents a summary of the capital, present worth of the operation and maintenance cost, and total present worth cost of each alternative.

7.5.1.4 Remedial Action Subsite 4. An itemized breakdown of the capital cost for all alternatives is presented in Appendix B. An itemized breakout of operation and maintenance costs is presented in Appendix C. Table 7.30 presents a summary of the capital, present worth of the operation and maintenance cost, and total present worth cost of each alternative.

Table 7.27

Summary of Cost for RASS 1

Alternative	Capital Cost (000$)	Present Worth of O&M Cost (000$)	Total Present Worth (000$)
Alternative 1-1	51	142	193
Alternative 1-2	173	1,483	1,656
Alternative 1-3A	7,737	1,261	8,998
Alternative 1-3C	4,416	1,261	5,677
Alternative 1-3D	4,615	2,840	7,455
Alternative 1-3E	8,466	1,261	9,727
Alternative 1-3F	8,257	1,670	9,927

Present Worth based on 30-year project life at 10% discount rate.

Table 7.28

Summary of Cost for RASS 2

Alternative	Capital Cost (000$)	Present Worth of O&M Cost (000$)	Total Present Worth (000$)
Alternative 2-1	19	142	161
Alternative 2-2	79	464	543
Alternative 2-3A	4,729	340	5,069
Alternative 2-3C	2,549	340	2,889
Alternative 2-3D	2,934	1,902	4,836
Alternative 2-3E	5,315	340	5,655
Alternative 2-3F	5,175	750	5,925

Present Worth based on 30-year project life at 10% discount rate.

Table 7.29

Summary of Cost for RASS 3

Alternative	Capital Cost (000$)	Present Worth of O&M Cost (000$)	Total Present Worth (000$)
Alternative 3-1	26	142	168
Alternative 3-2	201	453	654
Alternative 3-3A	2,335	301	2,636
Alternative 3-3C	1,780	301	2,081
Alternative 3-3D	1,884	1,878	3,762
Alternative 3-3E	2,760	301	3,061
Alternative 3-3F	2,667	705	3,372

Present Worth based on 30-year project life at 10% discount rate.

Table 7.30

Summary of Cost for RASS 4

Alternative	Capital Cost (000$)	Present Worth of O&M Cost (000$)	Total Present Worth (000$)
Alternative 4-1	8	142	150
Alternative 4-2	23	326	349
Alternative 4-3A	666	274	940
Alternative 4-3C	657	274	931
Alternative 4-3D	670	1,854	2,524
Alternative 4-3E	1,050	274	1,224
Alternative 4-3F	1,038	683	1,721
Alternative 4-4A	689	306	995
Alternative 4-4B	845	318	1,163

Present Worth based on 30-year project life at 10% discount rate.

7.5.2 Sensitivity Analysis

A sensitivity analysis was performed to assess the effect that assumptions associated with the design, implementation, operation, interest rate, and effective life can have on the estimated costs of the alternatives. These assumptions depend on the accuracy of the data developed during the investigation and on the prediction of the future performance of the remedial technology and are subject to varying degrees of uncertainty. Theoretically, the sensitivity of the costs to these uncertainties can be evaluated by varying the underlying assumptions and noting the effect on costs. It should be noted that with the exception of the soil washing process, the technologies selected for application at the various subsites on NWS Concord are demonstrated technologies with minimum cost uncertainty. On the otherhand, soil washing is a new technology with a limited cost data base.

7.5.2.1 Discount Rate Sensitivity. EPA (1985) recommends that the primary cost evaluation be conducted using a 10 percent discount rate. In addition, EPA (1985) recommends that a sensitivity analysis using different discount rates be performed to evaluate the impacts of changing discount rates on the relative cost ranking of the alternatives.

Sensitivity of the present worth of each alternative to changes in the discount was evaluated using discount rates of 6, 8, 10, and 12 percent. The results of this sensitivity analysis is summarized in Tables 7.31 through 7.34. For RASS's 1, 3, and 4, the cost ranking of individual alternatives was unaffected by changes in the discount rate. For RASS 2, the cost ranking for Alternatives 2-3A and 2-3D reversed between the 6 and 8 percent discount rate. This results from the assumptions made concerning the operation of a monofill on NWS Concord that is included in Alternative 2-3D (see section 7.5.2.2). If the joint monofill assumption is made (section 7.5.2.2), the ranking change would not occur. In addition, the absolute cost difference between the two alternatives is less than 2 percent, which is considerably less than the accuracy of the estimate.

7.5.2.2 Disposal Cost Sensitivity. The cost of alternatives using existing landfills for disposal of contaminated materials is subject to a variety of

Table 7.31

Summary of Present Worth for RASS 1

Alternative	*6	8	10	12
Alternative 1-1	258	220	193	172
Alternative 1-2	2,068	1,833	1,656	1,517
Alternative 1-3A	9,356	9,152	8,998	8,878
Alternative 1-3C	6,035	5,831	5,677	5,557
Alternative 1-3D	8,519	7,907	7,455	7,110
Alternative 1-3E	10,085	9,881	9,727	9,607
Alternative 1-3F	10,462	10,156	9,927	9,750

*Discount rate

Table 7.32

Summary of Present Worth for RASS 2

Alternative	*6	8	10	12
Alternative 2-1	226	188	161	140
Alternative 2-2	680	602	543	497
Alternative 2-3A	5,175	5,114	5,069	5,034
Alternative 2-3C	2,995	2,934	2,889	2,854
Alternative 2-3D	5,648	5,180	4,836	4,577
Alternative 2-3E	5,761	5,700	5,655	5,620
Alternative 2-3F	6,211	6,047	5,925	5,833

*Discount rate

Table 7.33

Summary of Present Worth for RASS 3

Alternative	*6	8	10	12
Alternative 3-1	233	195	168	147
Alternative 3-2	784	710	654	611
Alternative 3-3A	2,725	2,675	2,636	2,606
Alternative 3-3C	2,170	2,120	2,081	2,051
Alternative 3-3D	4,559	4,099	3,762	3,507
Alternative 3-3E	3,150	3,100	3,061	3,031
Alternative 3-3F	3,637	3,485	3,372	3,286

*Discount rate

Table 7.34

Summary of Present Worth for RASS 4

Alternative	*6	8	10	12
Alternative 4-1	215	177	150	129
Alternative 4-2	446	391	349	317
Alternative 4-3A	1,019	974	940	913
Alternative 4-3C	1,010	965	931	904
Alternative 4-3D	3,312	2,858	2,524	2,273
Alternative 4-3E	1,403	1,358	1,224	1,297
Alternative 4-3F	1,981	1,832	1,721	1,637
Alternative 4-4A	1,088	1,035	995	964
Alternative 4-4B	1,260	1,205	1,163	1,130

*Discount rate

cost uncertainties. These include transportation costs and existing facility disposal costs, monofill operation cost, and taxes and fees.

Transportation and Disposal Costs. The primary cost analysis assumes the use of truck transport to currently operating Class I facilities (Kettleman Hills and/or Imperial Valley) located in California. The transportation cost, based on personal communication with several sales representatives of major disposal disposal operations is estimated to be approximately $40. per ton. Competitive pressures between firms tend to have more effect on the transportation cost than the absolute distance between the remedial action site and the disposal facility.

Transportation by truck or rail to a landfill in Utah is also considered as an alternative. The transportation cost to Utah is estimated to be $115. and $70. per ton by truck and rail, respectively. These higher transportation costs are offset by a lower total disposal cost. Analysis of the total transportation and disposal costs for the various options is presented in Table 7.35.

Personal communications with sale representatives of major waste disposal firms indicate that substantial discounts, up to 15 percent, may be given for materials of the type and quantity that would be generated by the NWS Concord remedial actions. Assuming such a discount, the costs of alternatives incorporating disposal in existing Class I landfill would be reduced accordingly. Table 7.36 presents an analysis of the impact of disposal cost discounting on the cost of remediation.

Monofill Operation Cost. Operation of a monofill on NWS Concord for disposal of treated contaminated materials is an alternative. Because each RASS is evaluated independently, the total cost of remediation for all RASS's cannot be obtained by summation of the individual RASS costs for each alternative. There is some economy of scale for each alternative and significant economies of scale for those alternatives incorporating construction and operation of a monofill on NWS Concord. Of particular impact is the reduction of the annual operating cost for the monofill. Since the cost of operating a large landfill is essentially the same as a smaller landfill, the analysis indicates that if

Table 7.35

Summary of Transportation and Disposal Cost Options [1, 2]

COST ELEMENT	TRANSPORT-DISPOSAL OPTION			
	TRUCK-CALIFORNIA	TRUCK-UTAH	RAIL-UTAH	INTERMODAL-UTAH
CLASS I RCRA WASTE				
Disposal Cost	100.	140.	140.	140.
County Tax (10%)	10.	--	--	--
State Disposal Tax	36.	3.	3.	3.
Superfund Tax	45.	--	--	--
Transportation Cost	40.	115.	70.	100.
Total	231.	258.	213.	243.
CLASS I NON-RCRA				
Disposal Cost	100.	80.	80.	80.
County Tax (10%)	10.	--	--	--
State Disposal Tax	10.	--	--	--
Superfund Tax	6.	--	--	--
Transportation Cost	40.	115.	70.	100.
Total	166.	195.	150.	180.

[1] All Cost in $/ton.

[2] Taxes and fees subject to change.

Table 7.36

Cost Sensitivity of Disposal Options to Discount on Disposal Cost

Alternative	Current Estimate (000$)	Estimate Assuming 15% Disposal Discount (000$)	Percent Cost Reduction
1-3A	7,737	6,785	12
2-3A	4,729	4,154	12
3-3A	2,335	2,132	9
4-3A	666	606	9

all of the RASS's are considered together, the present worth of operating the landfill is approximately one-fourth the cost of considering the RASS's separately. Table 7.37 presents an analysis of the monofill operation assumption.

Taxes and Fees. A significant portion (21 percent) of the disposal cost assumed for the cost evaluation is taxes and fees to the State and county governments. An unresolved issue is the payment of such taxes and fees by the Federal government. This item has a significant impact on the cost of alternatives incorporating disposal in existing Class I landfills. Table 7.35 presents the impacts of these taxes and fees on the cost of disposal in existing landfills. Other taxes and fees (generator, treater, disposal facility operator) are not included in the cost estimates. Of particular importance is a prospective $100,000. per year disposal facility tax (fee) that could be applied to any monofills constructed on NWS Concord. This issue remains unresolved.

7.5.2.3 Area of Cleanup Sensitivity. For the conditions found on the four RASS's evaluated in this FS, the cost of remediation is a primarily a function of the area selected for active remediation. Although there may be some limited economies of scale, the major driving costs are linearly related to the area of cleanup. Plate 7.1 illustrates the cost of each alternative as a function of the area of cleanup.

Using this approximation of remediation cost per acre, Table 7.38 presents a comparison of the remediation costs for the selected criteria with the remediation costs associated with criteria other than those selected for each RASS.

7.6 Summary of Detailed Evaluation

A summary of the detailed evaluation for the remedial action alternatives for RASS 1, RASS 2, RASS 3, and RASS 4 is presented in Tables 7.39 through 7.42.

Table 7.37

Cost Sensitivity to Monofill Operation Assumption

Alternative	Cubic Yards	Percent Capacity	Capital Cost (000$)	O&M Present Worth Using Separate Monofill Assumption (000$)	Total Present Worth Using Separate Monofill Assumption (000$)	O&M Present Worth Using Joint Monofill Assumption (000$)	Total Present Worth Using Joint Monofill Assumption (000$)
1-3D	26,514	47.	4,615	2,840	7,455	2,214	6,829
2-3D	16,952	29.	2,934	1,902	4,836	1,064	3,998
3-3D	11,828	21.	1,884	1,878	3,762	945	2,829
4-3D	1,645	3.	670	1,854	2,524	709	1,379
Total	56,939	100.	10,103	8,474	18,577	4,932	15,035

Table 7.38

Sensitivity of Remediation Cost to Clean Up Criteria[1]

RASS/ALTERNATIVE	EXCEEDING TTLC/STLC	BARREN AREA	AREA OF CONT.	STAT.> REM.REF.	STAT.SIGN. BIOACC.	SELECTED CRITERIA
RASS 1	(15.40)	(1.03)	(32.04)	(19.24)	(29.51)	(9.03)
Alternative 1-1	0.17	0.16	0.19	0.18	0.19	0.16
1-2	2.58	0.19	5.34	3.22	4.92	1.52
1-3A	14.87	0.85	31.11	18.62	28.64	8.65
1-3C	9.13	0.77	18.82	11.37	17.34	5.43
1-3D	11.09	2.45	21.09	13.39	19.57	7.26
1-3E	15.95	1.16	33.07	19.90	30.46	9.39
1-3F	15.89	1.61	32.43	19.71	29.92	9.56
RASS 2	(3.75)	(1.23)	(5.11)	(2.44)	(2.40)	(4.17)
Alternative 2-1	0.16	0.16	0.16	0.16	0.16	0.16
2-2	0.65	0.23	0.87	0.43	0.42	0.71
2-3A	3.50	1.04	4.83	2.22	2.18	3.91
2-3C	2.35	0.89	3.14	1.59	1.57	2.60
2-3D	4.08	2.57	4.90	3.30	3.27	4.34
2-3E	3.96	1.36	5.36	2.61	2.57	4.39
2-3F	4.31	1.81	5.66	3.01	2.97	4.73
RASS 3	(1.92)	--	(5.67)	(4.58)	(3.77)	(4.66)
Alternative 3-1	0.16	--	0.16	0.16	0.16	0.16
3-2	0.34	--	0.96	0.78	0.65	0.80
3-3A	1.71	--	5.37	4.31	3.52	4.39
3-3C	1.29	--	3.47	2.84	2.36	2.88
3-3D	2.98	--	5.24	4.58	4.10	4.63
3-3E	2.07	--	5.93	4.81	3.98	4.89
3-3F	2.49	--	6.22	5.14	4.33	5.22
RASS 4	(0.56)	--	(1.41)	(0.19)	(0.08)	(0.87)
Alternative 4-1	0.16	--	0.16	0.15	0.15	0.16
4-2	0.12	--	0.26	0.05	0.04	0.17
4-3A	0.39	--	1.22	0.03	-0.08	0.69
4-3C	0.50	--	0.99	0.28	0.22	0.68
4-3D	2.17	--	2.68	1.94	1.88	2.35
4-3E	0.68	--	1.55	0.29	0.18	0.99
4-3F	1.14	--	1.98	0.77	0.66	1.45
4-4A	0.72	--	0.62	0.76	0.77	0.68
4-4B	0.98	--	1.09	0.93	0.92	1.02

[1] Costs are in millions of dollars present worth rounded to nearest 10,000.
( ) Area of remediation in acres.

Table 7.39

Summary of Detailed Evaluation for RASS 1 Alternatives

Alternative	Technical Feasibility Rating	Environmental Impacts Rating	Institutional Requirements Rating	Public Health Requirements Rating	Cost[1] Analysis ($ Millions)
1-1: No Action	Low	Low	Low	Low	0.193
1-2: Environmental Monitoring	Low	Low	Low	Low	1.656
1-3A: Excavation/Disposal in Existing Landfills/Restoration	High	High	High	High	8.998
1-3C: Excavation/Immobilization/ Disposal in Existing Landfills/Restoration	High	High	Moderate	High	5.677
1-3D: Excavation/Immobilization/ Disposal in Monofill on NWS Concord/Restoration	High	High	Moderate	High	7.455
1-3E: Excavation/Soil Washing/ Disposal in Existing Landfills/Restoration	Moderate	Moderate	Low	High	9.727
1-3F: Excavation/Soil Washing/ Disposal in Monofill on NWS Concord/Restoration	Moderate	Moderate	Low	High	9.927

1 Present Worth

Table 7.40

Summary of Detailed Evaluation for RASS 2 Alternatives

Alternative	Technical Feasibility Rating	Environmental Impacts Rating	Institutional Requirements Rating	Public Health Requirements Rating	Cost Analysis ($ Millions)
2-1: No Action	Low	Low	Low	Low	0.161
2-2: Environmental Monitoring	Low	Low	Low	Low	0.543
2-3A: Excavation/Disposal in Existing Landfills/Restoration	High	High	High	High	5.069
2-3C: Excavation/Immobilization Disposal in Existing Landfills/Restoration	High	High	Moderate	High	2.889
2-3D: Excavation/Immobilization/ Disposal in Monofill on NWS Concord/Restoration	High	High	Moderate	High	4.836
2-3E: Excavation/Soil Washing/ Disposal in Existing Landfills/Restoration	Moderate	Moderate	Low	High	5.655
2-3F: Excavation/Soil Washing/ Disposal in Monofill on NWS Concord/Restoration	Moderate	Moderate	Low	High	5.925

Table 7.41

Summary of Detailed Evaluation for RASS 3 Alternatives

Alternative	Technical Feasibility Rating	Environmental Impacts Rating	Institutional Requirements Rating	Public Health Requirements Rating	Cost Analysis ($ Millions)
3-1: No Action	Low	Low	Low	Low	0.168
3-2: Environmental Monitoring	Low	Low	Low	Low	0.654
3-3A: Excavation/Disposal in Existing Landfills	High	High	High	High	2.636
3-3C: Excavation/Immobilization/ Disposal in Existing Landfills	High	High	Moderate	High	2.081
3-3D: Excavation/Immobilization/ Disposal in Monofill on NWS Concord	High	High	Moderate	High	3.762
3-3E: Excavation/Soil Washing/ Disposal in Existing Landfills	Moderate	Moderate	Low	High	3.061
3-3F: Excavation/Soil Washing/ Disposal in Monofill on NWS Concord	Moderate	Moderate	Low	High	3.372

Table 7.42

Summary of Detailed Evaluation for RASS 4 Alternatives

Alternative	Technical Feasibility Rating	Environmental Impacts Rating	Institutional Requirements Rating	Public Health Requirements Rating	Cost Analysis ($ Millions)
4-1: No Action	Low	Low	Low	Low	0.150
4-2: Environmental Monitoring	Low	Low	Low	Low	0.349
4-3A: Excavation/Disposal in Existing Landfills	High	High	High	High	0.940
4-3C: Excavation/Immobilization/ Disposal in Existing Landfills	High	High	Moderate	High	0.931
4-3D: Excavation/Immobilization/ Disposal in Monofill on NWS Concord	High	High	Moderate	High	2.524
4-3E: Excavation/Soil Washing/ Disposal in Existing Landfills	Moderate	Moderate	Low	High	1.224
4-3F: Excavation/Soil Washing/ Disposal in Monofill on NWS Concord	Moderate	Moderate	Low	High	1.721
4-4A: Source Isolation/Soil Cap	Moderate	Moderate	Moderate	High	0.995
4-4B: Source Isolation/RCRA Cap	Moderate	Moderate	Moderate	High	1.163

8.0 RANKING AND SELECTION OF REMEDIAL ALTERNATIVES

This section presents a summary of the detailed evaluation of the remedial action alternatives in terms of the remedial technologies included in the alternatives; costs; and various evaluation criteria; including public health, environmental, technical, institutional, and other concerns. The advantages and disadvantages of each remedial alternative are discussed and the alternatives are ranked for each of the four sub-areas.

8.1 Summary of Remedial Technologies and Alternatives

Tables 8.1 through 8.4 summarize the remedial technologies that are included in each of the remedial alternatives for each RASS. These tables show the technologies that are common to the alternatives and those that are unique.

8.2 Ranking of Alternatives

8.2.1 Remedial Action Subsite 1

Table 8.5 presents a summary comparison of the detailed evaluation of remedial alternatives for RASS 1, based on the detailed discussions presented in Section 7.0. The following discusses the advantages and disadvantages of each alternative and presents the ranking of the alternatives.

8.2.1.1 Alternative 1-1: No Action

The major advantage of the no action alternative is its lowest total cost. The disadvantages include: continued migration of contaminated soils containing high levels of arsenic, cadmium, copper, lead, and zinc into the remainder of RASS 1 and high potential for continued bioaccumulation and toxic effects on aquatic and wetland biota, including endangered species.

8.2.1.2 Alternative 1-2: Environmental Monitoring

The major advantages of this alternative are a relatively low total cost and the ability to document the impacts associated with continued exposure of

Table 8.1

Summary of Remedial Technologies Included in Remedial Alternatives for RASS 1

Remedial Alternative	Site Security	Monitoring	Excavation	Wetland Restoration	Solid-ification/ Stabilization	Soil Washing	Existing Landfills	New Landfills	Drainage Improvements	Soil Cap	RCRA Cap	In Situ Chemical Treatment
Alternative 1-1: No Action	X	--	--	--	--	--	--	--	--	--	--	--
Alternative 1-2: Environmental Monitoring	X	X	--	--	--	--	--	--	--	--	--	--
Alternative 1-3A: Excavation/ Disposal In Existing Land-fills/Restoration	X	X	X	X	--	--	X	--	X	--	--	--
Alternative 1-3C: Excavation/ Immobilization/ Disposal In Exist-ing Landfills/ Restoration	X	X	X	X	X	--	X	--	X	--	--	--
Alternative 1-3D: Excavation/ Immobilization/ Disposal In Monofill on NWS Concord/Restoration	X	X	X	X	X	--	--	X	X	--	--	--
Alternative 1-3E: Excavation/Soil Washing/ Disposal In Existing Land-fills/Restoration	X	X	X	X	--	X	X	--	X	--	--	--
Alternative 1-3F: Excavation/Soil Washing/ Disposal In Monofill on NWS Concord/ Restoration	X	X	X	X	--	X	--	X	X	--	--	--

Table 8.2

Summary of Remedial Technologies Included in Remedial Alternatives for RASS 2

Remedial Alternative	Site Security	Monitoring	Excavation	Wetland Restoration	Solid-ification/ Stabilization	Soil Washing	Existing Landfills	New Landfills	Drainage Improvements	Soil Cap	RCRA Cap	In Situ Chemical Treatment
Alternative 2-1: No Action	X	--	--	--	--	--	--	--	--	--	--	--
Alternative 2-2: Environmental Monitoring	X	X	--	--	--	--	--	--	--	--	--	--
Alternative 2-3A: Excavation/ Disposal In Existing Land-fills/Restoration	X	X	X	X	--	--	X	--	X	--	--	--
Alternative 2-3C: Excavation/ Immobilization/ Disposal In Existing Land-fills/Restoration	X	X	X	X	X	--	--	X	X	--	--	--
Alternative 2-3D: Excavation/ Immobilization/ Disposal In Monofill on NWS Concord/ Restoration	X	X	X	X	X	--	--	X	X	--	--	--
Alternative 2-3E: Excavation/Soil Washing/Disposal In Existing Landfills/ Restoration	X	X	X	X	--	X	X	--	X	--	--	--
Alternative 2-3F: Excavation/Soil Washing/Disposal In Monofill on NWS Concord/ Restoration	X	X	X	X	--	X	--	X	X	--	--	--

Table 8.3

Summary of Remedial Technologies Included in Remedial Alternatives for RASS 3

Remedial Alternative	Site Security	Monitoring	Excavation	Wetland Restoration	Solid-ification/ Stabilization	Soil Washing	Existing Landfills	New Landfills	Drainage Improvements	Soil Cap	RCRA Cap	In Situ Chemical Treatment
Alternative 3-1: No Action	X	--	--	--	--	--	--	--	--	--	--	--
Alternative 3-2: Environmental Monitoring	X	X	--	--	--	--	--	--	--	--	--	--
Alternative 3-3A: Excavation/ Disposal In Existing Land-fills	X	X	X	--	--	--	X	--	X	--	--	--
Alternative 3-3C: Excavation/ Immobilization/ Disposal In Existing Land-fills	X	X	X	--	X	--	X	--	X	--	--	--
Alternative 3-3D: Excavation/ Immobilization/ Disposal In Monofill on NWS Concord	X	X	X	--	X	--	--	X	X	--	--	--
Alternative 3-3E: Excavation/Soil Washing/Disposal In Existing Landfills	X	X	X	--	--	X	X	--	X	--	--	--
Alternative 3-3F: Excavation/Soil Washing/Disposal In Monofill on NWS Concord	X	X	X	--	--	X	--	X	X	--	--	--

Table 8.4

Summary of Remedial Technologies Included in Remedial Alternatives for RASS 4

Remedial Alternative	Site Security	Monitoring	Excavation	Wetland Restoration	Solid-ification/ Stabilization	Soil Washing	Existing Landfills	New Landfills	Drainage Improvements	Soil Cap	RCRA Cap	In Situ Chemical Treatment
Alternative 4-1: No Action	X	--	--	--	--	--	--	--	--	--	--	--
Alternative 4-2: Environmental Monitoring	X	X	--	--	--	--	--	--	--	--	--	--
Alternative 4-3A: Excavation/ Disposal In Existing Land-fills	X	X	X	--	--	--	X	--	X	--	--	--
Alternative 4-3C: Excavation/ Immobilization/ Disposal In Existing Land-fills	X	X	X	--	X	--	X	--	X	--	--	--
Alternative 4-3D: Excavation/ Immobilization/ Disposal In Monofill on NWS Concord	X	X	X	--	X	--	--	X	X	--	--	--
Alternative 4-3E: Excavation/Soil Washing/Disposal In Existing Landfills	X	X	X	--	--	X	X	--	X	--	--	--
Alternative 4-3F: Excavation/Soil Washing/Disposal In Monofill on NWS Concord	X	X	X	--	--	X	--	X	X	--	--	--
Alternative 4-4A: Source Isolation/ Soil Cap	X	X	--	--	--	--	--	--	X	X	--	X
Alternative 4-4B: Source Isolation/ RCRA Cap	X	X	--	--	--	--	--	--	--	--	X	X

Table 8.5

Summary of Detailed Evaluation of Remedial Alternatives for RASS I

Remedial Alternative	Public Health Concerns	Environmental Concerns	Technical Concerns	Institutional Concerns	Other Concerns
Alternative 1-1: No Action	o Minimal worker risk. o Continued potential for direct contact with contaminated soils.	o Contaminated sediment remains onsite. o High potential for continued biological uptake of contaminants. o Continued resuspension redistribution of contaminated soils.	o Minimal	o Arsenic and heavy metals not removed.	
Alternative 1-2: Environmental Monitoring	o Minimal worker risk. o Continued potential for direct contact with contaminated soils.	o Contaminated sediment remains on-site. o High potential for continued biological uptake of contaminants. o Continued resuspension redistribution of contaminated soils.	o Development of action levels.	o Arsenic and heavy metals not removed.	
Alternative 1-3A: Excavation/ Disposal in Existing Landfills/ Restoration	o Worker risk during remediation. o Transportation accidents causing public exposure o Minimizes potential for long term direct contact.	o Removes significant quantities of contaminated soils. o Significantly reduces migration of heavy metals and arsenic. o Eliminate toxic effects on wetland biota. o Restores 9.03 acres of wetland. o Short term impacts on endangered species. o Minimizes resuspension and redistribution of contaminated soils.	o Proven technology. o Heavy construction traffic in wetlands. o Wetland restoration. o Development of action levels.	o Consumes existing landfill space. o Some contamination left on-site.	o Traffic through towns. o Restoration of wetland could take longer than expected. o High cost

Table 8.5 (Continued)

Remedial Alternative	Public Health Concerns	Environmental Concerns	Technical Concerns	Institutional Concerns	Other Concerns
Alternative 1-3C: Excavation/ Immobilization/ Disposal in Existing Landfills/ Restoration	o Worker risk during remediation. o Transportation accidents causing public exposure. o Minimizes potential for long term direct contact.	o Removes significant quantities of contaminated soils. o Significantly reduces migration of heavy metals and arsenic. o Eliminate toxic effects on wetland biota. o Restores 9.03 acres of wetland. o Short term impacts on endangered species. o Minimizes resuspension and redistribution of contaminated soils.	o Proven technology. o Heavy construction traffic in wetlands. o Wetland restoration. o Development of a S/S process. o Co-Disposal. o Development of action levels.	o Consumes existing landfill space. o Some contamination left onsite.	o Traffic through towns. o Restoration of wetland could take longer than expected.
Alternative 1-3D: Excavation/ Immobilization/ Disposal in Monofill on NWS Concord/ Restoration	o Worker risk during remediation. o Minimizes potential for long term direct contact.	o Removes significant quantities of contaminated soils. o Significantly reduces migration of heavy metals and arsenic. o Eliminate toxic effects on wetland biota. o Restores 9.03 acres of wetland. o Short term impacts on endangered species. o Minimizes resuspension and redistribution of contaminated soils.	o Proven technology. o Heavy construction traffic in wetlands. o Wetland restoration. o Development of a S/S process. o Development of action levels.	o Loss of land use on NWS Concord (13 acres) o Some contamination left onsite. o Location, design, and construction of monofill. o Long term operation of monofill.	o Traffic through towns. o Restoration of wetland could take longer than expected.

Table 8.5 (Concluded)

Remedial Alternative	Public Health Concerns	Environmental Concerns	Technical Concerns	Institutional Concerns	Other Concerns
Alternative 1-3E: Excavation/ Soil Washing/ Disposal in Existing Landfills/ Restoration	o Worker risk during remediation. o Transportation accidents causing public exposure. o Minimizes potential for long term direct contact. o Minimizes resuspension and redistribution of contaminated soils. o Produces contaminated rich sludge.	o Removes significant quantities of contaminated soils. o Significantly reduces migration of heavy metals and arsenic. o Eliminate toxic effects on wetland biota. o Restores 9.03 acres of wetland. o Short term impacts on endangered species.	o Unproven technology. o Heavy construction traffic in wetlands. o Wetland restoration. o Development of action levels. o Development of soil washing process.	o Consumes existing landfill space. o Some contamination left onsite.	o Traffic through towns. o Restoration of wetland could take longer than expected.
Alternative 1-3F: Excavation/ Soil Washing/ Disposal in Monofill on NWS Concord/ Restoration	o Worker risk during remediation. o Transportation accidents causing public exposure. o Minimizes potential for long term direct contact. o Produces contaminant rich sludge.	o Removes significant quantities of contaminated soils. o Significantly reduces migration of heavy metals and arsenic. o Eliminate toxic effects on wetland biota. o Restores 9.03 acres of wetland. o Short term impacts on endangered species. o Minimizes resuspension and redistribution of contaminated soils.	o Unproven technology. o Heavy construction traffic in wetlands. o Wetland restoration. o Development of soil washing process. o Development of action levels.	o Loss of land use on NWS Concord (12 acres). o Some contamination left onsite. o Location, design, and construction of monofill. o Long term operation monofill.	o Traffic through towns. o Restoration of wetland could take longer than expected.

wetland biota to levels of arsenic and heavy metals and migration of contamination. The disadvantages include: continued migration of contaminated soils containing high levels of arsenic, cadmium, lead, and zinc into the remainder of RASS 1 and high potential for continued bioaccumulation and toxic effects on aquatic and wetland biota, including endangered species.

8.2.1.3 Alternative 1-3A: Excavation/Disposal in Existing Landfills

The advantages of this alternative include the removal of a large percentage of contamination from the RASS, using proven and effective technology; use of existing land disposal facilities, where the regulatory structure is in place to ensure that the materials are disposed of in an environmentally acceptable manner; and restoration of 9.03 acres of wetland as habitat for endangered species. The disadvantages include: high cost; increased safety problems associated with the transportation of large quantities of contaminated materials through populated areas; short term impacts on the wetland areas inhabited by endangered species; and consumption of existing landfill space that may be more efficiently used for higher priority and more hazardous materials. Because of environmental concerns, approximately 23.01 acres of contaminated soil is not removed.

8.2.1.4 Alternative 1-3C: Excavation/Immobilization/Disposal in Existing Landfills

The advantages of this alternative include the removal of a large percentage of contamination from the RASS, using proven and effective technology; immobilization of the arsenic and heavy metals in the excavated soils using chemical solidification technology; use of existing land disposal facilities, where the regulatory structure is in place to ensure that the materials are disposed of in an environmentally acceptable manner; and restoration of 9.03 acres of wetland as habitat for endangered species. This alternative uses a technology that significantly reduces the toxicity or mobility of the contaminants, as preferred by CERCLA (Section 121(b)(1)). The disadvantages include: relatively high cost, increased safety problems associated with the transportation of large quantities of materials through populated areas; short term impacts

on wetland areas inhabited by endangered species; increase in waste volume resulting from the chemical solidification process; concerns over the long term durability of the solidified soils, especially in a Class III landfill environment; concerns over the stabilization of arsenic; and consumption of existing landfill space that may be more efficiently used for higher priority and more hazardous materials. Because of environmental concerns, approximately 23.01 acres of contaminated soils is not removed.

8.2.1.5 Alternative 1-3D: Excavation/Immobilization/Disposal in a Monofill Located on NWS Concord

The advantages of this alternative include the removal of a large percentage of contamination from the RASS, using proven and effective technology; immobilization of the arsenic and heavy metals in the excavated soils using chemical solidification technology; reduction of transportation costs and associated safety concerns by disposing of solidified/stabilized materials in a monofill located on NWS Concord; and restoration of 9.03 acres of wetland as habitat for endangered species. This alternative uses a technology that significantly reduces the toxicity or mobility of the contaminants, as preferred by CERCLA (Section 121(b)(1)). The disadvantages include: relatively high cost; short term impacts on wetland areas inhabited by endangered species; concerns over the long term durability of solidified/stabilized materials, although to a lesser extent than in Alternative 1-3C, i.e., the treated soils are not exposed to an acidic Class III environment; increased volume of wastes resulting from the solidification process; concerns over the stabilization of arsenic; loss of alternative use on land required for the monofill; and long term operation requirements of the monofill. Because of environmental concerns, approximately 23.01 acres of contaminated soil is not removed. Approximately 13 acres of land are required for the monofill.

8.2.1.6 Alternative 1-3E: Excavation/Soil Washing/Disposal in Existing Landfills

The advantages of this alternative include the removal of a large percentage of contamination from the RASS, using proven and effective technology;

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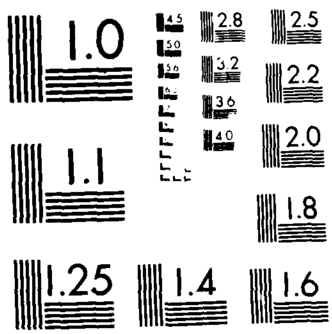
1.0
1.1
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2.8
3.2
3.6
4.0
4.5
5.0
5.6

removing arsenic and heavy metals from the excavated soils and concentrating them in a smaller volume using chemical soil washing technology; use of existing land disposal facilities, where the regulatory structure is in place to ensure that the materials are disposed of in environmentally acceptable manner; and restoration of 9.03 acres of wetland as habitat for endangered species. This alternative uses a technology that significantly reduces the volume of the hazardous substances, as preferred by CERCLA (Section 121(b)(1)). The disadvantages include: high cost, safety problems associated with the transportation of large quantities of materials through populated areas, short term impacts on the wetland areas inhabited by endangered species, consumption of existing landfill space, disposal of sludges generated by the soil washing process, and use of a relatively unproven technology, requiring extensive laboratory and pilot scale testing. Because of environmental concerns, approximately 23.01 acres of contaminated soil is not removed.

8.2.1.7 Alternative 1-3F: Excavation/Soil Washing/Disposal in a Monofill Located on NWS Concord

The advantages of this alternative include the removal of a large percentage of contamination from the RASS, using proven and effective technology; removing the arsenic and heavy metals from the excavated soils and concentrating them in a smaller volume using chemical soil washing technology; reduction of transportation costs and associated safety concerns by disposing of decontaminated materials in a monofill located on NWS Concord; and restoration of 9.03 acres of wetland as habitat for endangered species. This alternative uses a technology that significantly reduces the volume of the hazardous substances, as preferred by CERCLA (Section 121(b)(1)). The disadvantages include: high cost, short term impacts on the wetland areas inhabited by endangered species, use of a relatively unproven technology for treatment of the contaminated soils, potential safety problems associated with the transport of residual sludges to existing landfills, loss of alternative use on land required for the monofill, and requirement for long term operation of a monofill on NWS Concord. Because of environmental concerns, approximately 23.01 acres of contaminated soil is not removed. Approximately 12 acres of land are required for the monofill.

8.2.1.8 Summary of Alternative Ranking for RASS 1

Based on the above discussions, the detailed evaluations presented in Section 7, and the conclusion that there is a need for action on RASS 1, all the alternatives were compared and ranked as follows.

First Alternative. Alternative 1-3C. Alternative 1-3C (Excavation/Immobilization/Disposal in an Existing Landfill) is considered as the most favorable alternative. Removal of the contaminated soils and sediments from the RASS and treating the soils with a solidification/stabilization process is more reliable than the no action or environmental monitoring alternatives with respect to elimination of migration of metals and long term reduction of the public health and environmental risk.

Among the removal alternatives considered, Alternative 1-3C is the least cost alternative. The next higher alternative cost (Alternative 1-3D) is slightly higher in cost, because of the long term commitment to operation of a monofill on the NWS Concord.

Disposal of the solidified/stabilized materials in an existing Class III landfill will require approval of State regulatory agencies. As an alternative to disposal in a Class III landfill, the treated soils could be transported to a Class I facility. Classification of the treated soils will depend on the outcome of laboratory and pilot scale testing. Alternative 1-3C uses a Section 121(b)(1) preferred technology and includes a wetland restoration element.

Second Alternative. Alternative 1-3A (Excavation/Disposal at Existing Landfill/Restoration) is considered as the second alternative. A primary consideration in evaluation of Alternative 1-3A is its high present worth and the transport of large quantities of Class I materials over public roadways. Although the transport considerations could be largely minimized through the use of rail transport, costs are higher than those associated with Alternatives 1-3C or 1-3D. However, competitive bidding processes could reduce the cost of this alternative by approximately twelve percent which makes this alternative more competitive with Alternative 1-3D. Another consideration in

ranking this alternative was the institutional concern over the consumption of Class I landfill space that can be utilized for higher priority waste materials. State regulatory personnel have expressed concern over the use of existing landfills for this purpose. Alternative 1-3A does not use a Section 121(b)(1) preferred technology; however, this alternative includes a wetland restoration element. Implementation of Alternative 1-3A does not require long term operation and maintenance of a landfill.

Third Alternative. Alternative 1-3D (Excavation/Immobilization/Disposal at Monofill on NWS Concord/Restoration) is considered as the third preferred alternative. This alternative is comparable to Alternative 1-3C except that it requires construction of a monofill on NWS Concord. Although the solidification/stabilization of the soils would limit the mobility of the arsenic and heavy metals, because of geological considerations and uncertainties over the long term stability of solidified/stabilized soils, the monofill would be constructed and operated to Class I engineering standards, thus increasing the cost of this alternative. However, siting studies at NWS Concord have revealed that no sites meet the California siting requirements for a Class I landfill. Allocation of approximately 13 acres on NWS Concord for use as the monofill site would be required. Alternative 1-3D uses a Section 121(b)(1) preferred technology and includes a wetland restoration element. Monofill construction and operation requires long term operation and maintenance.

Fourth Alternative. Alternatives 1-3E (Excavation/Soil Washing/Disposal at Existing Landfills/Restoration) and 1-3F (Excavation/Soil Washing/Disposal at Monofills on NWS Concord/Restoration) are considered jointly as the fourth alternative. Primary considerations in ranking these alternatives were the high cost and relative unproven soil washing technology upon which both depend. Alternatives 1-3E and 1-3F use a Section 121(b)(1) preferred technology and include a wetland restoration element.

Fifth Alternative. Alternative 1-2 (Environmental Monitoring) is ranked fifth and is preferred over the no action alternative. The soils and sediments found on RASS 1 have been contaminated with high concentrations of arsenic and heavy metals. Bioaccumulation and migration of contaminants have been

documented. Although the removal alternatives provide significantly greater protection of the public health and environment, an absolute minimal response would include implementation of an environmental monitoring program.

Sixth Alternative. Alternative 1-1 (No Action) is ranked last because of the reasons described by Lee et al. (1986,1988). The no action alternative is considered to be an unacceptable approach to deal with the existing public health and environmental concerns.

8.2.2 Remedial Action Subsite 2

Table 8.6 presents a summary comparison of the detailed evaluation of remedial alternatives for RASS 2, based on the detailed discussions presented in Section 7.0. The following discusses the advantages and disadvantages of each alternative and presents the ranking of the alternatives.

8.2.2.1 Alternative 2-1: No Action

The major advantage of the no action alternative is its lowest total cost. The disadvantages include: continued migration of contaminated soils containing high levels of cadmium, lead, and zinc into the remainder of RASS 2 and high potential for continued bioaccumulation and toxic effects on upland, aquatic, and wetland biota, including endangered species.

8.2.2.2 Alternative 2-2: Environmental Monitoring

The major advantages of this alternative are the ability to document the impacts associated with continued exposure of wetland biota to levels of heavy metals and migration of contamination and a comparatively low total cost. The disadvantages include: continued migration of contaminated soils containing high levels of cadmium, lead, and zinc into the remainder of RASS 2 and high potential for continued bioaccumulation and toxic effects on upland, aquatic, and wetland biota, including endangered species.

Table 8.6

Summary of Detailed Evaluation of Remedial Alternatives for RASS 2

Remedial Alternative	Public Health Concerns	Environmental Concerns	Technical Concerns	Institutional Concerns	Other Concerns
Alternative 2-1: No Action	o Minimal worker risk. o Continued potential for direct contact with contaminated soils.	o Contaminated sediment remains onsite. o High potential for continued biological uptake of contaminants. o Long term impact on endangered species. o Continued resuspension redistribution of contaminated soils.	o Minimal	o Arsenic and heavy metals not removed.	
Alternative 2-2: Environmental Monitoring	o Minimal worker risk. o Continued potential for direct contact with contaminated soils.	o Contaminated sediment remains on-site. o High potential for continued biological uptake of contaminants. o Long term impact on endangered species. o Continued resuspension redistribution of contaminated soils.	o Development of action levels.	o Arsenic and heavy metals not removed.	
Alternative 2-3A: Excavation/ Disposal in Existing Landfills/ Restoration	o Worker risk during remediation. o Transportation accidents causing public exposure. o Minimizes potential for long term direct contact.	o Removes significant quantities of contaminated soils. o Significantly reduces migration of heavy metals and arsenic. o Eliminate toxic effects on wetland biota.	o Proven technology. o Heavy construction traffic in wetlands. o Wetland restoration. o Development of action levels.	o Consumes existing landfill space. o Some contamination left on-site.	o Traffic through towns. o Restoration of wetland could take longer than expected.

Table 8.6 (Continued)

Remedial Alternative	Public Health Concerns	Environmental Concerns	Technical Concerns	Institutional Concerns	Other Concerns
		o Restores 4.17 acres of wetland. o Short term impacts on endangered species. o Minimizes resuspension and redistribution of contaminated soils.			
Alternative 2-3C: Excavation/ Immobilization/ Disposal in Existing Land-fills/Restoration	o Worker risk during re-mediation. o Transportation accidents causing public exposure. o Minimizes potential for long term direct contact.	o Removes significant quantities of contami-nated soils. o Significantly reduces migration of heavy metals and arsenic. o Eliminate toxic effects on wetland biota. o Restores 4.17 acres of wetland. o Short term impacts on endangered species. o Minimizes resuspension and redistribution of contaminated soils.	o Proven technology. o Heavy construction traffic in wetlands. o Wetland restoration. o Development of S/S process. o Co-Disposal. o Development of action levels.	o Consumes existing landfill space. o Some contamination left onsite.	o Traffic through towns. o Restoration of wetland could take longer than expected.
Alternative 2-3D: Excavation/ Immobilization/ Disposal in Monofill on NWS Concord/ Restoration	o Worker risk during re-mediation. o Transportation accidents causing public exposure. o Minimizes potential for long term direct contact.	o Removes significant quantities of contami-nated soils. o Significantly reduces migration of heavy metals and arsenic. o Eliminate toxic effects on wetland biota. o Restores 4.17 acres of wetland.	o Proven technology. o Heavy construction traffic in wetlands. o Wetland restoration. o Development of a S/S process. o Development of action levels.	o Loss of land use on NWS Concord (11 acres). o Some contamination left on-site. o Location, design, and construction of monofill. o Long term operation of monofill.	o Traffic through towns. o Restoration of wetland could take longer than expected.

Table 8.6 (Concluded)

Remedial Alternative	Public Health Concerns	Environmental Concerns	Technical Concerns	Institutional Concerns	Other Concerns
		o Short term impacts on endangered species. o Minimizes resuspension and redistribution of contaminated soils.			
Alternative 2-3E: Excavation/ Soil Washing/ Disposal in Existing Landfills/ Restoration	o Worker risk during remediation. o Transportation accidents causing public exposure. o Minimizes potential for long term direct contact.	o Removes significant quantities of contaminated soils. o Significantly reduces migration of heavy metals and arsenic. o Eliminate toxic effects on wetland biota. o Restores 4.17 acres of wetland. o Short term impacts on endangered species. o Minimizes resuspension and redistribution of contaminated soils.	o Unproven technology. o Heavy construction traffic in wetlands. o Development of action levels. o Wetland restoration. o Development of soil washing process.	o Consumes existing landfill space. o Some contamination left on-site.	o Traffic through towns. o Restoration of wetland could take longer than expected.
Alternative 2-3F: Excavation/ Soil Washing/ Disposal in Monofill on NWS Concord/ Restoration	o Worker risk during remediation. o Transportation accidents causing public exposure. o Minimizes potential for long term direct contact.	o Removes significant quantities of contaminated soils. o Significantly reduces migration of heavy metals and arsenic. o Eliminate toxic effects on wetland biota. o Restores 4.14 acres of wetland. o Short term impacts on endangered species. o Minimizes resuspension and redistribution of contaminated soils.	o Unproven technology. o Heavy construction traffic in wetlands. o Wetland restoration. o Development of soil washing process.	o Loss of land use on NWS Concord (10 acres). o Some contamination left on-site. o Location, design, and construction of monofill. o Development of action levels. o Long term operation of monofill.	o Traffic through towns. o Restoration of wetland could take longer than expected.

8.2.2.3 Alternative 2-3A: Excavation/Disposal in Existing Landfills

The advantages of this alternative include the removal of a large percentage of contamination from the RASS, using proven and effective technology; use of existing land disposal facilities, where the regulatory structure is in place to ensure that the materials are disposed of in an environmentally acceptable manner; and restoration of 4.17 acres of wetland as habitat for endangered species. The disadvantages include: high cost; increased safety problems associated with the transportation of large quantities of contaminated materials through populated areas; short term impacts on the wetland areas inhabited by endangered species; and consumption of existing landfill space that may be more efficiently used for higher priority waste materials. Because of environmental concerns, 0.94 acres of contaminated soils are not removed.

8.2.2.4 Alternative 2-3C: Excavation/Immobilization/Disposal in Existing Landfills

The advantages of this alternative include the removal of a large percentage of contamination from the RASS, using proven and effective technology; immobilization of the arsenic and heavy metals in the excavated soils using chemical solidification technology; use of existing land disposal facilities, where the regulatory structure is in place to ensure that the materials are disposed of in an environmentally acceptable manner, and restoration of 4.14 acres of wetland as habitat for endangered species. This alternative uses a technology that significantly reduces the toxicity or mobility of the contaminants, as preferred by CERCLA (Section 121(b)(1)). The disadvantages include: relatively high cost; increased safety problems associated with the transportation of large quantities of materials through populated areas; short term impacts on wetland areas inhabited by endangered species; increase in waste volume resulting from the chemical solidification process; concerns over the long term durability of the solidified soils, especially in a Class III environment; and consumption of existing landfill space. Because of environmental concerns, 0.94 acres of contaminated soils are not removed.

8.2.2.5 Alternative 2-3D: Excavation/Immobilization/Disposal in a Monofill Located on NWS Concord

The advantages of this alternative include the removal of a large percentage of contamination from the RASS, using proven and effective technology; immobilization of the arsenic and heavy metals in the excavated soils using chemical solidification technology; reduction of transportation costs and associated safety concerns by disposing of solidified/stabilized materials in a monofill located on NWS Concord, and restoration of 4.14 acres of wetland habitat for endangered species. This alternative uses a technology that significantly reduces the toxicity or mobility of the contaminants, as preferred by CERCLA (Section 121(b)(1)). The disadvantages include: relatively high cost; short term impacts on the wetland areas inhabited by endangered species; concerns over the long term durability of solidified/stabilized materials; although to a lesser extent than Alternative 2-3C, i.e., the treated soils are not exposed to an acidic Class III environment; increased volume of wastes resulting from the solidification process; loss of alternative use on land required by the monofill; and long term operation requirements of the monofill. Approximately 11 acres of land are required for the monofill. Because of environmental concerns, 0.94 acres of contaminated soil are not removed.

8.2.2.6 Alternative 2-3E: Excavation/Soil Washing/Disposal in Existing Landfills

The advantages of this alternative include the removal of a large percentage of contamination from the RASS, using proven and effective technology; removing heavy metals from the excavated soils and concentrating them in a smaller volume using chemical soil washing technology; use of existing land disposal facilities, where the regulatory structure is in place to ensure that the materials are disposed of in environmentally acceptable manner, and restoration of 4.17 acres of wetland habitat for endangered species. This alternative uses a technology that significantly reduces the volume of the hazardous substances, as preferred by CERCLA (Section 121(b)(1)). The disadvantages include: high cost, safety problems associated with the transportation of large quantities of materials through populated areas, short term impacts on wetland areas inhabited by endangered species, consumption of existing

landfill space, disposal of sludges generated by the soil washing process, and use of a relatively unproven technology, requiring extensive laboratory and pilot scale testing. Because of environmental concerns, 0.94 acres of contaminated soil is not removed.

8.2.2.7 Alternative 2-3F: Excavation/Soil Washing/Disposal in a Monofill Located on NWS Concord

The advantages of this alternative include the removal of a large percentage of contamination from the RASS, using proven and effective technology; removing the arsenic and heavy metals from the excavated soils and concentrating them in a smaller volume using chemical soil washing technology; reduction of transportation costs and associated safety concerns by disposing of decontaminated materials in a monofill located on NWS Concord, and restoration of 4.17 acres of wetland as habitat for endangered species. Because of environmental concerns, 0.94 acres of contaminated soil are not removed. This alternative uses a technology that significantly reduces the volume of the hazardous substances, as preferred by CERCLA (Section 121(b)(1)). The disadvantages include: high cost, short term impacts on wetland areas inhabited by endangered species, use of a relatively unproven technology for treatment of the contaminated soils, potential safety problems associated with the transport of residual sludges to existing landfills, loss of alternative use on land required for the monofill, and requirement for long term operation of a monofill on NWS Concord. Approximately 10 acres of land are required for the monofill.

8.2.2.8 Summary of Alternative Ranking for RASS 2

Based on the above discussions, the detailed evaluations presented in Section 7, and the conclusion that there is a need for action of RASS 2, all the alternatives were compared and ranked as follows.

First Alternative. Alternative 2-3C. Alternative 2-3C (Excavation/Immobilization/Disposal in an Existing Landfill) is considered as the most favorable alternative. Removal of the contaminated soils and sediments from the RASS and treating the soils with a solidification/stabilization process is

more reliable than the no action or environmental monitoring alternatives with respect to elimination of migration of metals and long term reduction of the public health and environmental risk.

Among the removal alternatives considered, Alternative 2-3C is the least cost alternative. The next higher cost alternative (Alternative 2-3D) is higher in cost, because of the long term commitment to operation of a monofill on the NWS Concord.

Disposal of the solidified/stabilized materials in an existing Class III landfill will require approval of State regulatory agencies. As an alternative to disposal in a Class III landfill, the treated soils could be transported to a Class I facility. Classification of the treated soils will depend on the outcome of laboratory and pilot scale testing. Alternative 2-3C uses a Section 121(b)(1) preferred technology and includes a wetland restoration element.

Second Alternative. Alternative 2-3A (Excavation/Disposal at Existing Landfills/Restoration) is considered as the second alternative. A primary consideration in evaluation of Alternative 2-3A is its high present worth and the transport of large quantities of Class I materials over public roadways. Although the transport considerations would be largely minimized through the use of rail transport, costs are considerably higher than those associated with Alternatives 2-3C or 2-3D. However, competitive bidding processes could reduce the cost of this alternative by approximately twelve percent which makes it less costly than Alternative 2-3D. Another consideration in ranking this alternative is the institutional concern over the consumption of Class I landfill space that can be utilized for higher priority waste materials. State regulatory personnel have expressed concern over the use of existing landfills for this purpose. Alternative 2-3A does not use a Section 121(b)(1) preferred technology; however, it does include a wetland restoration element. Implementation of Alternative 2-3A does not require long term operation of a landfill.

Third Alternative. Alternative 2-3D (Excavation/Immobilization/Disposal at Monofill on NWS Concord/Restoration) is considered as the third preferred

alternative. This alternative is comparable to Alternative 2-3C except that it requires construction of a monofill on NWS Concord. Although the solidification/stabilization of the soils would limit the mobility of the arsenic and heavy metals, because of geological considerations and uncertainties over the long term stability of solidified/stabilized soils, the monofill would be constructed and operated to Class I engineering standards, thus increasing the cost of this alternative. Allocation of approximately 10 acres on NWS Concord for use as the monofill site would be required. Alternative 2-3D uses a Section 121(b)(1) preferred technology and includes a wetland restoration element. Monofill construction and maintenance requires long term operation and maintenance.

Fourth Alternative. Alternatives 2-3E (Excavation/Soil Washing/Disposal at Existing Landfills/Restoration) and 2-3F (Excavation/Soil Washing/Disposal At Monofill on NWS Concord/Restoration) are considered jointly as the fourth alternative. Primary considerations in ranking these alternatives were the high cost and relatively unproven soil washing technology upon which both depend. Alternatives 2-3E and 2-3F use a Section 121(b)(1) preferred technology and includes a wetland restoration element.

Fifth Alternative. Alternative 2-2 (Environmental Monitoring) is ranked fifth and is preferred over the no action alternative. The soils and sediments found on RASS 2 have been contaminated with high concentrations of heavy metals. Bioaccumulation and migration of contaminants have been documented. Although the removal alternatives provide significantly greater protection of the public health and environment, an absolute minimal response would include implementation of an environmental monitoring program. The no action alternative is considered to be an unacceptable approach to deal with the existing public health and environmental concerns.

Sixth Alternative. Alternative 2-1 (No Action) is ranked last because of the reasons described by Lee et al. (1986, 1988).

8.2.3 Remedial Action Subsite 3

Table 8.7 presents a summary comparison of the detailed evaluation of remedial alternatives for RASS 3, based on the detailed discussions presented in Section 7.0. The following discusses the advantages and disadvantages of each alternative and presents the ranking of the alternatives.

8.2.3.1 Alternative 3-1: No Action

The major advantage of the no action alternative is its lowest total cost. The disadvantages include: continued migration of contaminated soils containing high levels of cadmium, lead, and zinc into the remainder of RASS 3 and potentially into RASS 1 and RASS 2 and high potential for continued bioaccumulation and toxic effects on aquatic and wetland biota, including endangered species.

8.2.3.2 Alternative 3-2: Environmental Monitoring

The major advantages of this alternative are the ability to document the impacts associated with continued exposure of wetland biota to levels of heavy metals and migration of contamination and a comparatively low total cost. The disadvantages include: continued migration of contaminated soils containing high levels of cadmium, lead, and zinc into the remainder of RASS 3 and potentially onto RASS 1 and RASS 2 and high potential for continued bioaccumulation and toxic effects on aquatic and wetland biota, including endangered species.

8.2.3.3 Alternative 3-3A: Excavation/Disposal in Existing Landfills

The advantages of this alternative include the removal of a large percentage of contamination from the RASS, using proven and effective technology; use of existing land disposal facilities, where the regulatory structure is in place to ensure that the materials are disposed of in an environmentally acceptable manner; and reduced migration of contaminants into RASS 1 and RASS 2, which are wetland habitat for endangered species. The disadvantages include: high cost; increased safety problems associated with the transportation of large quantities of contaminated materials through populated areas; short term

Table 8.7

Summary of Detailed Evaluation of Remedial Alternatives for RASS 3

Remedial Alternative	Public Health Concerns	Environmental Concerns	Technical Concerns	Institutional Concerns	Other Concerns
Alternative 3-1: No Action	o Minimal worker risk. o Continued potential for direct contact with contaminated soils.	o Contaminated soil remains onsite. o High potential for continued biological uptake of contaminants. o Continued resuspension redistribution of contaminated soils.	o Minimal	o Heavy metals not removed.	
Alternative 3-2: Environmental Monitoring	o Minimal worker risk. o Continued potential for direct contact with contaminated soils.	o Contaminated soil remains on-site. o High potential for continued biological uptake of contaminants. o Continued resuspension redistribution of contaminated soils.	o Development of action levels.	o Heavy metals not removed.	
Alternative 3-3A: Excavation/ Disposal in Existing Landfills	o Worker risk during remediation. o Transportation accidents causing public exposure. o Minimizes potential for long term direct contact.	o Removes significant quantities of contaminated soils. o Significantly reduces migration of heavy metals. o Eliminate toxic effects on biota. o Short term impacts on habitat. o Minimizes resuspension and redistribution of contaminated soil.	o Proven technology. o Heavy construction traffic in wetlands. o Development of action levels.	o Consumes existing landfill space. o Some contamination left onsite.	o Traffic through towns.

Table 8.7 (Continued)

Remedial Alternative	Public Health Concerns	Environmental Concerns	Technical Concerns	Institutional Concerns	Other Concerns
Alternative 3-3C: Excavation/ Immobilization/ Disposal in Existing Landfills	o Worker risk during remediation. o Transportation accidents causing public exposure. o Minimizes potential for long term direct contact.	o Removes significant quantities of contaminated soils. o Significantly reduces migration of heavy metals and arsenic. o Eliminate toxic effects on wetland biota. o Short term impacts on habitat. o Minimizes resuspension and redistribution of contaminated soils.	o Proven technology. o Heavy construction traffic in wetlands. o Development of S/S process. o Co-Disposal. o Development of action levels.	o Consumes existing landfill space. o Some contamination left onsite.	o Traffic through towns.
Alternative 3-3D: Excavation/ Immobilization/ Disposal in Monofill on NWS Concord	o Worker risk during remediation. o Transportation accidents causing public exposure. o Minimizes potential for long term direct contact.	o Removes significant quantities of contaminated soils. o Significantly reduces migration of heavy metals and arsenic. o Eliminate toxic effects on wetland biota. o Short term impacts on endangered species. o Minimizes resuspension and redistribution of contaminated soils.	o Proven technology. o Heavy construction traffic in wetlands. o Development of a S/S process. o Development of action levels.	o Loss of land use on NWS Concord (11 acres). o Some contamination left onsite. o Location, design, and construction of monofill.	o Traffic through towns.

Table 8.7 (Concluded)

Remedial Alternative	Public Health Concerns	Environmental Concerns	Technical Concerns	Institutional Concerns	Other Concerns
Alternative 3-3E: Excavation/ Soil Washing/ Disposal in Existing Landfills	o Worker risk during remediation. o Transportation accidents causing public exposure. o Minimizes potential for long term direct contact.	o Removes significant quantities of contaminated soils. o Significantly reduces migration of heavy metals and arsenic. o Eliminate toxic effects on wetland biota. o Short term impacts on endangered species. o Minimizes resuspension and redistribution of contaminated soils.	o Unproven technology. o Heavy construction traffic in wetlands. o Development of action levels. o Development of soil washing process.	o Consumes existing landfill space. o Some contamination left onsite.	o Traffic through towns.
Alternative 3-3F: Excavation/ Soil Washing/ Disposal in Monofill on NWS Concord	o Worker risk during remediation. o Transportation accidents causing public exposure. o Minimizes potential for long term direct contact.	o Removes significant quantities of contaminated soils. o Significantly reduces migration of heavy metals and arsenic. o Eliminate toxic effects on biota. o Short term impacts on habitat. o Minimizes resuspension and redistribution of contaminated soils.	o Unproven technology. o Heavy construction traffic in wetlands. o Development of soil washing process. o Development of action levels.	o Loss of land use on NWS Concord (10 acres). o Some contamination left onsite. o Location, design, and construction of monofill. o Long term operation of monofill.	o Traffic through towns.

impacts on the wetland areas; and consumption of existing landfill space that may be more efficiently used for higher priority waste materials.

8.2.3.4 <u>Alternative 3-3C: Excavation/Immobilization/Disposal in Existing Landfills</u>

The advantages of this alternative include the removal of a large percentage of contamination from the RASS, using proven and effective technology; immobilization of the heavy metals in the excavated soils using chemical solidification technology; and use of existing land disposal facilities, where the regulatory structure is in place to ensure that the materials are disposed of in an environmentally acceptable manner. This alternative uses a technology that significantly reduces the toxicity or mobility of the contaminants, as preferred by CERCLA (Section 121(b)(1)). The disadvantages include: relatively high cost; increased safety problems associated with the transportation of large quantities of materials through populated areas; short term impacts on wetland areas; increase in waste volume resulting from the chemical solidification process; concerns about the long term durability of the solidified soils, especially in a Class III environment; and consumption of existing landfill space.

8.2.3.5 <u>Alternative 3-3D: Excavation/Immobilization/Disposal in a Monofill Located on NWS Concord</u>

The advantages of this alternative include the removal of a large percentage of contamination from the RASS, using proven and effective technology; immobilization of heavy metals in the excavated soils using chemical solidification technology; and reduction of transportation costs and associated safety concerns by disposing of solidified/stabilized materials in a monofill located on NWS Concord. This alternative uses a technology that significantly reduces the toxicity or mobility of the contaminants, as preferred by CERCLA (Section 121(b)(1)). The disadvantages include: relatively high cost; short term impacts on the wetland areas; concerns over the long term durability of solidified/stabilized materials, although to a lesser extent than Alternative 3-3C, i.e., the treated soils are not exposed to an acidic Class III environment; increased volume of wastes resulting from the solidification

process; loss of alternative use on land required by the monofill; and long term operation requirements of the monofill. Approximately 11 acres of land are required for the monofill.

8.2.3.6 Alternative 3-3E: Excavation/Soil Washing/Disposal in Existing Landfills

The advantages of this alternative include the removal of a large percentage of contamination from the RASS, using proven and effective technology; removing heavy metals from the excavated soils and concentrating them in a smaller volume using chemical soil washing technology; and use of existing land disposal facilities, where the regulatory structure is in place to ensure that the materials are disposed of in environmentally acceptable manner. This alternative uses a technology that significantly reduces the volume of the hazardous substances, as preferred by CERCLA (Section 121(b)(1)). The disadvantages include: high cost, safety problems associated with the transportation of large quantities of materials through populated areas, short term impacts on wetland areas, consumption of existing landfill space, disposal of sludges generated by the soil washing process, and use of a relatively unproven technology, requiring extensive laboratory and pilot scale testing.

8.2.3.7 Alternative 3-3F: Excavation/Soil Washing/Disposal in a Monofill Located on NWS Concord

The advantages of this alternative include the removal of a large percentage of contamination from the RASS, using proven and effective technology; removing heavy metals from the excavated soils and concentrating them in a smaller volume using chemical soil washing technology; and reduction of transportation costs and associated safety concerns by disposing of decontaminated materials in a monofill located on NWS Concord. This alternative uses a technology that significantly reduces the volume of the hazardous substances, as preferred by CERCLA (Section 121(b)(1)). The disadvantages include: high cost, short term impacts on the wetland areas, use of a relatively unproven technology for treatment of the contaminated soils, potential safety problems associated with the transport of residual sludges to existing landfills, loss of alternative use on land required by the monofill, and requirement for long term operation

of a monofill on NWS Concord. Approximately 10 acres of land are required for the monofill.

8.2.3.8 Summary of Alternative Ranking for RASS 3

Based on the above discussions, the detailed evaluations presented in Section 7, and the conclusion that there is a need for action on RASS 3, all the alternatives were compared and ranked as follows.

First Alternative. Alternative 3-3C (Excavation/Immobilization/Disposal in an Existing Landfill) is considered as the most favorable alternative. Removal of the contaminated soils and sediments from the RASS and treating the soils with a solidification/stabilization process is more reliable than the no action or environmental monitoring alternatives with respect to elimination of migration of metals and long term reduction of the public health and environmental risk.

Among the removal alternatives considered, Alternative 3-3C is the least cost alternative. The next higher cost alternative (Alternative 3-3A) is slightly higher in cost.

Disposal of the solidified/stabilized materials in an existing Class III landfill will require approval of State regulatory agencies. As an alternative, the treated materials could be transported to a Class I facility. Classification of the treated soils will depend on the outcome of laboratory and pilot scale testing. Alternative 3-3C uses a Section 121(b)(1) preferred technology.

Second Alternative. Alternative 3-3A (Excavation/Disposal at Existing Landfills/Restoration) is considered as the second alternative. A primary consideration in evaluation of Alternative 3-3A is its higher present worth than Alternative 3-3C and the transport of large quantities of Class I materials over public roadways. However, competitive bidding processes could reduce the cost of this alternative by approximately nine percent making this alternative only slightly higher in cost than Alternative 3-3C. Another consideration in ranking this alternative was the institutional concern over the

consumption of Class I landfill space that can be utilized for higher priority waste materials. State regulatory personnel have expressed concern over the use of existing landfills for this purpose. Alternative 3-3A does not use a Section 121(b)(1) preferred technology.

Third Alternative. Alternative 3-3D (Excavation/Immobilization/Disposal at Monofill NWS Concord) is considered as the third preferred alternative. This alternative is comparable to Alternative 3-3C except that it requires construction of a monofill on NWS Concord. Although the solidification/stabilization of the soils would limit the mobility of the heavy metals, because of geological considerations and uncertainties over the long term stability of solidified/stabilized soils, the monofill would be constructed and operated to Class I engineering standards, thus increasing the cost of this alternative. Allocation of approximately 11 acres on NWS Concord for use as the monofill site would be required. Alternative 3-3D uses a Section 121(b)(1) preferred technology. Monofill construction and operation requires long term operation and maintenance.

Fourth Alternative. Alternatives 3-3E (Excavation/Soil Washing/Disposal at Existing Landfills) and 3-3F (Excavation/Soil Washing/Disposal at Monofill on NWS Concord) are considered jointly as the fourth alternative. Primary considerations in ranking these alternatives were the high cost and relative unproven soil washing technology upon which both depend. Alternatives 3-3E and 3-3F use a Section 121(b)(1) preferred technology.

Fifth Alternative. Alternative 3-2 (Environmental Monitoring) is ranked fifth and is preferred over the no action alternative. The soils and sediments found on RASS 3 have been contaminated with high concentrations of heavy metals. Bioaccumulation and migration of contaminants have been documented. Although the removal alternatives provide significantly greater protection of the public health and environment, an absolute minimal response would include implementation of an environmental monitoring program. The no action alternative is considered to be an unacceptable approach to deal with the existing public health and environmental concerns.

Sixth Alternative. Alternative 3-1 (No Action) is ranked last because of the adverse environmental impacts described by Lee et al. (1986, 1988).

8.2.4 Remedial Action Subsite 4

Table 8.8 presents a summary comparison of the detailed evaluation of remedial alternatives for RASS 4, based on the detailed discussions presented in Section 7.0. The following discusses the advantages and disadvantages of each alternative and presents the ranking of the alternatives.

8.2.4.1 Alternative 4-1: No Action

The major advantage of the no action alternative is its lowest total cost. The disadvantages include: continued migration of contaminated soils containing high levels of cadmium, lead, and zinc and high potential for continued bioaccumulation and toxic effects on upland, aquatic and wetland biota.

8.2.4.2 Alternative 4-2: Environmental Monitoring

The major advantages of this alternative are the ability to document the impacts associated with continued exposure of biota to levels of heavy metals and migration of contamination and a comparatively low total cost. The disadvantages include: continued migration of contaminated soils containing high levels of cadmium, lead, and zinc into the remainder of RASS 4 and high potential for continued bioaccumulation and toxic effects on upland, aquatic and wetland biota.

8.2.4.3 Alternative 4-3A: Excavation/Disposal in Existing Landfills

The advantages of this alternative include the removal of a large percentage of contamination from the RASS, using proven and effective technology; use of existing land disposal facilities, where the regulatory structure is in place to ensure that the materials are disposed of in an environmentally acceptable manner; and reduced migration of contaminants. The disadvantages include: high cost; increased safety problems associated with the transportation of large quantities of contaminated materials through populated areas; and

Table 8.8

Summary of Detailed Evaluation of Remedial Alternatives for RASS 4

Remedial Alternative	Public Health Concerns	Environmental Concerns	Technical Concerns	Institutional Concerns	Other Concerns
Alternative 4-1: No Action	o Minimal worker risk. o Continued potential for direct contact with contaminated soils. o Continued resuspension redistribution of contaminated soils.	o Contaminated soil remains onsite. o High potential for continued biological uptake of contaminants.	o Minimal	o Arsenic and heavy metals not removed.	
Alternative 4-2: Environmental Monitoring	o Minimal worker risk. o Continued potential for direct contact with contaminated soils. o Continued resuspension redistribution of contaminated soils.	o Contaminated soil remains onsite. o High potential for continued biological uptake of contaminants.	o Development of action levels.	o Arsenic and heavy metals not removed.	
Alternative 4-3A: Excavation/ Disposal in Existing Landfills	o Worker risk during remediation. o Transportation accidents causing public exposure. o Minimizes potential for long term direct contact. o Minimizes resuspension and redistribution of contaminated soils.	o Removes significant quantities of contaminated soil. o Significantly reduces migration of heavy metals and arsenic. o Eliminate toxic effects on biota.	o Proven technology. o Frequency for reapplication of lime treatment.	o Consumes existing landfill space. o Some contamination left onsite. o Development of action levels.	o Traffic through towns.

Table 8.8 (Continued)

Remedial Alternative	Public Health Concerns	Environmental Concerns	Technical Concerns	Institutional Concerns	Other Concerns
Alternative 4-3C: Excavation/ Immobilization/ Disposal in Existing Landfills	o Worker risk during remediation. o Transportation accidents causing public exposure. o Minimizes potential for long term direct contact. o Minimizes resuspension and redistribution of contaminated soils.	o Removes significant quantities of contaminated soils. o Significantly reduces migration of heavy metals and arsenic. o Eliminate toxic effects on biota.	o Proven technology. o Frequency for reapplication on lime treatment. o Development of S/S process. o Co-Disposal.	o Consumes existing landfill space. o Some contamination left on-site. o Development of action levels.	o Traffic through towns.
Alternative 4-3D: Excavation/ Immobilization/ Disposal in Monofill on NWS Concord	o Worker risk during remediation. o Transportation accidents causing public exposure. o Minimizes potential for long term direct contact. o Minimizes resuspension and redistribution of contaminated soils.	o Removes significant quantities of contaminated soils. o Significantly reduces migration of heavy metals and arsenic. o Eliminate toxic effects on biota.	o Proven technology. o Development of a S/S process. o Frequency for reapplication of lime treatment.	o Loss of land use on NWS Concord (8 acres). o Some contamination left onsite. o Location, design, and construction of monofill. o Development of action levels. o Long term operation of monofill.	o Traffic through towns.
Alternative 4-3E: Excavation/ Soil Washing/ Disposal in Existing Landfills	o Worker risk during remediation. o Transportation accidents causing public exposure. o Minimizes potential for long term direct contact. o Minimizes resuspension and redistribution of contaminated soils. o Contaminants concentrated in sludge.	o Removes significant quantities of contaminated soils. o Significantly reduces migration of heavy metals and arsenic. o Eliminate toxic effects on biota.	o Unproven technology. o Development of *soil washing* process. o Frequency for reapplication of lime treatment.	o Consumes existing landfill space. o Some contamination left on-site. o Development of action levels.	o Traffic through towns.

Table 8.8 (Concluded)

Remedial Alternative	Public Health Concerns	Environmental Concerns	Technical Concerns	Institutional Concerns	Other Concerns
Alternative 4-3F: Excavation/ Soil Washing/ Disposal in Monofill on NWS Concord	o Worker risk during remediation. o Transportation accidents causing public exposure. o Minimizes potential for long term direct contact. o Minimizes resuspension and redistribution of contaminated soils. o Contaminants concentrated in sludge.	o Removes significant quantities of contaminated soils. o Significantly reduces migration of heavy metals and arsenic. o Eliminate toxic effects on biota.	o Unproven technology. o Development of soil washing process. o Frequency for reapplication of lime treatment.	o Loss of land use on NWS Concord (7 acres). o Some contamination left on-site. o Location, design, and construction of monofill. o Development of action levels. o Long term operation of monofill.	o Traffic through towns.
Alternative 4-4A: Source Isolation/ Soil Cap	o Worker Risk.	o Contaminated soil remains on site. o Possible change to hydrology and thus floral composition. o Increased sedimentation during construction. o Potential for leaching into groundwater.	o Proven technology. o Frequency for reapplication of lime of lime treatment.	o Design and construction of cap. o Development of action levels. o Adverse effects on adjacent wetlands. o Long term maintenance of cap. o Loss of alternative land use.	
Alternative 4-4B: Source Isolation/ RCRA Cap levels.	o Worker Risk.	o Contaminated soils remain on site. o Possible change to hydrology and thus floral composition. o Increased sedimentation during construction.	o Proven technology. o Frequency for reapplication of lime treatment.	o Design and construction of cap. o Development of action levels. o Adverse effects on adjacent wetlands. o Long term maintenance of cap. o Loss of alternative land use.	

consumption of existing landfill space that may be more efficiently used for higher priority waste materials.

8.2.4.4 Alternative 4-3C: Excavation/Immobilization/Disposal in Existing Landfills

The advantages of this alternative include the removal of a large percentage of contamination from the RASS, using proven and effective technology; immobilization of the heavy metals in the excavated soils using chemical solidification technology; and use of existing land disposal facilities, where the regulatory structure is in place to ensure that the materials are disposed of in an environmentally acceptable manner. This alternative uses a technology that significantly reduces the toxicity or mobility of the contaminants, as preferred by CERCLA (Section 121(b)(1)). The disadvantages include: relatively high cost; increased safety problems associated with the transportation of large quantities of materials through populated areas; increase in waste volume resulting from the chemical solidification process; concerns about the long term durability of the solidified soils, especially in a Class III environment; and consumption of existing landfill space.

8.2.4.5 Alternative 4-3D: Excavation/Immobilization/Disposal in a Monofill Located on NWS Concord

The advantages of this alternative include the removal of a large percentage of contamination from the RASS, using proven and effective technology; immobilization of heavy metals in the excavated soils using chemical solidification technology; and reduction of transportation costs and associated safety concerns by disposing of solidified/stabilized materials in a monofill located on NWS Concord. This alternative uses a technology that significantly reduces the toxicity or mobility of the contaminants, as preferred by CERCLA (Section 121(b)(1)). The disadvantages include: relatively high cost; concerns over the long term durability of solidified/stabilized materials, although to a lesser extent than Alternative 4-3C, i.e., the treated soil is not exposed to an acidic Class III environment; increased volume of wastes resulting from the solidification process; loss of alternative use on land required by the

monofill; and long term operation requirements of the monofill. Approximately 8 acres of land are required for the monofill.

8.2.4.6 Alternative 4-3E: Excavation/Soil Washing/Disposal in Existing Landfills

The advantages of this alternative include the removal of a large percentage of contamination from the RASS, using proven and effective technology; removing heavy metals from the excavated soils and concentrating them in a smaller volume using chemical soil washing technology; and use of existing land disposal facilities, where the regulatory structure is in place to ensure that the materials are disposed of in environmentally acceptable manner. This alternative uses a technology that significantly reduces the volume of the hazardous substances, as preferred by CERCLA (Section 121(b)(1)). The disadvantages include: high cost, safety problems associated with the transportation of large quantities of materials through populated areas, consumption of existing landfill space, disposal of sludges generated by the soil washing process, and use of a relatively unproven technology, requiring extensive laboratory and pilot scale testing.

8.2.4.7 Alternative 4-3F: Excavation/Soil Washing/Disposal in a Monofill Located on NWS Concord

The advantages of this alternative include the removal of a large percentage of contamination from the RASS, using proven and effective technology; removing heavy metals from the excavated soils and concentrating them in a smaller volume using chemical soil washing technology; and reduction of transportation costs and associated safety concerns by disposing of decontaminated materials in a monofill located on NWS Concord. This alternative uses a technology that significantly reduces the volume of the hazardous substances, as preferred by CERCLA (Section 121(b)(1)). The disadvantages include: high cost, use of a relatively unproven technology for treatment of the contaminated soils, potential safety problems associated with the transport of residual sludges to existing landfills, loss of alternative use on land required by the monofill, and requirement for long term operation of a monofill on NWS Concord. Approximately 7 acres of land are required for the monofill.

8.2.4.8 Alternative 4-4A: Source Isolation/Soil Cap

The advantages of this alternative include relatively low cost and isolation of contaminants from surface hydrologic phenomena using a proven technology. Disadvantages include changes to the habitat caused by raising the elevation and shape of the landform, loss of unrestricted use of the land, contaminants are left onsite and possibly exposed or migrate if the capping technology fails, and long term operation requirements associated with maintenance of the cap. This alternative does not use a Section 121(b)(1) preferred technology.

8.2.4.9 Alternative 4-4B: Source Isolation/RCRA Cap

The advantages of this alternative include relative low cost and isolation of contaminants from surface and subsurface hydrologic phenomena using a proven technology. Disadvantages include changes to the habitat caused by raising the elevation and shape of the landform, loss of unrestricted use of the land, contaminants are left on site and possibly exposed or migrate if the capping technology fails, and long term operation requirements associated with maintenance of the cap. This alternative does not use a Section 121(b)(1) preferred technology.

8.2.4.10 Summary of Alternative Ranking for RASS 4

Based on the above discussions, the detailed evaluations presented in Section 7, and the conclusion that there is a need for action on RASS 4, all the alternatives were compared and ranked as follows.

First Alternative. Alternative 4-3C (Excavation/Immobilization/Disposal in an Existing Landfill) is considered as the most favorable alternative. Removal of the contaminated soils and sediments from the RASS and treating the soils with a solidification/stabilization process is more reliable than the no action or environmental monitoring alternatives with respect to elimination of migration of metals and long term reduction of the public health and environmental risk.

Among the removal alternatives considered, Alternative 4-3C is the least cost alternative. The next higher cost alternative (Alternative 4-3A) is slightly higher in cost. The cost difference is probably not significant within the limitation of the cost estimating methodology.

Disposal of the solidified/stabilized materials in an existing Class III landfill will require approval of State regulatory agencies. An alternative is to transport the materials to a Class I facility. Classification of the treated soils will depend on the outcome of laboratory and pilot scale testing. Alternative 4-3C uses a Section 121(b)(1) preferred technology.

Second Alternative. Alternative 4-3A (Excavation/Disposal at Existing Landfills) is considered as the second alternative. A primary consideration in evaluation of Alternative 4-3A is the transport of large quantities of Class I materials over public roadways. Transport considerations could be largely minimized through the use of rail transport. Competitive bidding processes could reduce the cost of this alternative by approximately nine percent making this alternative more cost effective than Alternative 4-3C. Another consideration in ranking this alternative was the institutional concern over the consumption of Class I landfill space that can be utilized for higher priority waste materials. State regulatory personnel have expressed concern over the use of existing landfills for this purpose. Alternative 4-3A does not use a Section 121(b)(1) preferred technology.

Third Alternative. Alternative 4-4B (Source Isolation/RCRA Cap) is considered to be the third alternative. Source isolation using a RCRA cap is a proven technology that can be implemented under the conditions existing on RASS 4. The primary rational for ranking Alternative 4-4B as the third alternative is the relatively low cost and the added protection provided against contaminant migration into ground water. Although migration of contaminants into the ground water has not been demonstrated, Alternative 4-4B provides additional protection against such migration. This alternative is more reliable than Alternative 4-4A. This added reliability is attained with the nominal increase in cost. Alternative 4-4B is ranked behind the removal and solidification alternative because of reliability concerns related to leaving contamination onsite.

Fourth Alternative. Alternative 4-4A (Source Isolation/Soil Cap) is considered as the fourth alternative. Alternative 4-4A is ranked as the fourth alternative primarily because of its relatively low cost. Alternative 4-4A is considered to be slightly less reliable than Alternative 4-4B. Contamination is left on site and the RCRA cap (Alternative 4-4B) provides additional protection against contaminant migration at nominally higher cost.

Fifth Alternative. Alternative 4-3D (Excavation/Immobilization/Disposal at Monofill on NWS Concord) is considered as the fifth preferred alternative. This alternative is comparable to Alternative 4-3C except that it requires construction of a monofill on NWS Concord. Although the solidification/stabilization of the soils would limit the mobility of the heavy metals, because of geological considerations and uncertainties over the long term stability of solidified/stabilized soils, the monofill would be constructed and operated to Class I engineering standards, thus increasing the cost of this alternative. Allocation of approximately 11 acres on NWS Concord for use as the monofill site would be required. Alternative 4-3D uses a Section 121(b)(1) preferred technology.

Sixth Alternative. Alternatives 4-3E (Excavation/Soil Washing/Disposal at Existing Landfills) and 4-3F (Excavation/Soil Washing/Disposal at Monofill on NWS Concord) are considered jointly as the fourth alternative. Primary considerations in ranking these alternatives were the high cost and relative unproven soil washing technology upon which both depend. Alternatives 4-3E and 4-3F use a Section 121(b)(1) preferred technology.

Seventh Alternative. Alternative 4-2 (Environmental Monitoring) is ranked fifth and is preferred over the no action alternative. The soils and sediments found on RASS 4 have been contaminated with high concentrations of heavy metals. Bioaccumulation and migration of contaminants have been documented. Although the removal alternatives provide significantly greater protection of the public health and environment, an absolute minimal response would include implementation of an environmental monitoring program. The no action alternative is considered to be an unacceptable approach to deal with the existing public health and environmental concerns.

Eighth Alternative. Alternative 4-1 (No Action) is ranked last because of the adverse environmental impacts described by Lee et al. (1986, 1988).

8.3 Considerations in Implementing Remedial Alternatives

Although the remedial action site has been subdivided into four sub-areas to facilitate the selection of cleanup criteria and evaluation of remedial action alternatives for each of the sub-areas, design and implementation of remedial actions should take into consideration the site in its entirety. Some of the considerations are discussed below.

8.3.1 Project Staging

Execution of the remedial actions should be carried out in a staged manner, according to the potential for downstream migration of contamination during remediation activities. Remedial action activities should generally proceed from upstream to downstream. Remediation activities on RASS 3 should be completed prior to such activities on RASS 1 and RASS 2. Activities on RASS 2 and RASS 1 should be conducted concurrently, or in the alternative, remediation on RASS 2 should be conducted prior to remediation on RASS 1. This sequence is recommended so that the possibility of contaminant redistribution into remediated areas will be minimized.

8.3.2 Monofill Construction and Operation

Should it be necessary to implement alternatives that include monofill construction, the monofill should be sized to include materials from all sites. If an excavation alternative is selected for all sites, the required landfill area is estimated to be 3 acres for active landfilling operations plus 12 acres for buffer zones.

Operation of a single monofill for all RASS's covered by this FS would result in significant cost savings.

8.3.3 Environmental Monitoring

Alternatives in each RASS incorporate environmental monitoring. Since the RASS's are located in the same general area, consideration should be given to the development of a single comprehensive monitoring plan for the entire remediation site rather than the individual subsites. This would probably result in some economies of scale and resultant cost savings.

8.3.4 Ground Water

Investigations conducted to date indicate that migration of contaminants via the ground water pathway is not a concern for any of the RASS's included in this study. The Navy has proposed additional investigations of the ground water pathway (US Navy 1987). These investigations will be conducted in calendar years 1988 and 1989. The proposed remedial actions are source removal actions that can proceed independently from the ground water investigation and any potential remediation of the ground water. However, since monitoring wells are proposed in areas considered for active remediation, coordination will be required to ensure minimum disturbance of the monitoring wells during remediation activities.

8.3.5 Site Support Activities

Implementation of each alternative in each RASS includes cost items for site support, such as worker health and safety support, laboratories, administrative. Because of the close proximity of the individual RASS's, it may be possible to consolidate these types of facilities with a resulting cost savings.

9.0 REFERENCES

Allied Chemical. 1977. Review of Ground Water Monitoring Data from 1977 In-House Study.

Anderson Geotechnical Consultants, Inc. 1984. "Confirmation Study Report 2 NWS, Concord (Draft)," Department of the Navy, Naval Facilities Engineering Command, San Bruno, CA.

Beckett, P. H. T., and Davis, R. D. 1977. "Upper Critical Levels of Toxic Elements in Plants," New Phytol., Vol 79, pp 95-106.

Brown and Caldwell. 1985. "Letter Report to Carl Schwab subject Pore Water Sampling."

Brubaker, Gaylen R. and Everett L. Crockett, 1986. "In-situ Aquifer Remediation Using Enhanced Bioreclamation," Proceedings: IV Annual Hazardous Materials Management Conference, June, 1986.

California Department of Fish and Game. 1987. Letter to Mr. Cornelius dated 8 April 1987.

California Department of Water Resources. 1978. Wind in California. DWR Bull. No. 185.

Chaney, R. L. 1983. "Potential Effects of Waste Constituents on the Food Chain in Land Treatment of Hazardous Wastes," Noyes Data Corporation, N.J., pp 152-240.

Coats, B. 1986. "Letter Report-The February 1986 Flood at Concord Naval Weapons Station," April 4, 1986, Phillip Williams and Associates, San Francisco, CA.

Coats, B. 1987. "Memorandum-San Francisco Bay Tides," January 9, 1987, Phillip Williams and Associates, San Francisco, California.

Comprehensive Environmental Response, Compensation and Liability Act (Superfund) as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA).

Cullinane, M. J., Jr.; Lee, C. R., O'Neil, L. J., and Clairain, E. J. 1986. "Feasibility Study of Contamination Remediation at Naval Weapons Station, Concord California, Final Draft Report," U.S. Army Engineer Waterways Experiment Station, Miscellaneous Paper EL 86-3, Vicksburg, MS.

Davis, R. D., and Beckett, P. H. T. 1978. "Upper Critical Levels of Toxic Elements in Plants. II. Critical Levels of Copper in Young Barley, Wheat, Rape, Lettuce, and Ryegrass, and of Nickel and Zinc in Young Barley and Ryegrass," New Phytology, Vol 80, pp 23-32.

Davis, R. D., Beckett, P. H. T., and Wollan, E. 1978. "Critical Levels of Twenty Potentially Toxic Elements in Young Spring Barley," Plant Soil, Vol 49, pp 395-408.

Department of Health Services. 1984. California Assessment Manual.

Department of Health Services. 1988. Letter Transmitting State ARAR's.

Department of Health Services. 1986. "California Site Mitigation Decision Tree," Sacramento, CA.

Dev, Harsh, 1986. "Radio Frequency Enhanced In-situ Decontamination of Soils Contaminated with Halogenated Hydrocarbons," Land Disposal, Remedial Action, Incineration and Treatment of Hazardous Waste, Proceedings of the Twelfth Annual Research Symposium, U.S. Environmental Protection Agency, August, 1986.

Ecology and Environment, Inc. 1983. "Initial Assessment Study of Naval Weapons Station, Concord, California," NEESA 13-013, Naval Energy and Environmental Support Activity, Port Hueneme, CA.

Ellis, William, D., Thomas R. Fogg, and Anthony N. Tafuri, 1986. "Treatment of Soils Contaminated with Heavy Metals," Land Disposal, Remedial Action, Incineration and Treatment of Hazardous Waste, Proceedings of the Twelfth Annual Research Symposium, U.S. Environmental Protection Agency, August, 1986.

Environmental Field Services. 1988. Personal communication with Mr. Dave Listiak, January 13, 1988.

Federal Register. 1981. Executive Order 12316, 46 Federal Register 42237, 14 August.

Harding-Lawson Associates. 1977. Soil and Geologic Investigation Bay Point Works, Pittsburg, CA. Report prepared for Allied Chemical Company. Concord, CA. 35 pp.

Harris, D. L. 1981. "Tides and Tidal Datums in the United States." U.S. Army Corps of Engineers Special Report No. 7. Coastal Engineering Res. Cent. Ft. Belvoir, VA. 382 pp.

Henderson, F. M. 1966. Open Channel Flow. MacMillan Co. New York, NY, 522 p.

Holnigren, G. G. S., Meyer, M. W., Daniels, R. B., Chaney, R. L., and Kubota, J. 1987. "Cadmium, Lead, Zinc, Copper, and Nickel in Agricultural Soils of the United States," Journal of Environmental Quality (in press).

Huang, C. P., H. A. Elliot and R. M. Ashmead. 1977. "Interfacial reactions and the fate of heavy metals in soil-water systems." Journal of Water Poll. Cont. Fed. 49 (5):745-756.

Iskandar, Iskandar K., Lawrence B. Perry, Thomas F. Jenkins and Janet M. Houthoofd, 1986. "Effect of Freezing on the Level of Contaminants in Uncontrolled Hazardous Waste Sites - Part II: Preliminary Results," Land Disposal, Remedial action, Incineration and Treatment of Hazardous Waste, Proceedings of the Twelfth Annual Research Symposium, U.S. Environmental Protection Agency, August, 1986.

IT Corporation. 1982. "California Hazardous Waste Manifests From IT Corporation," (Document Numbers KCR000013-KCR000052).

IT Corporation. 1983. "California Hazardous Waste Manifests From IT Corporation," (Document Numbers KCR000223-KCR000394).

Josselyn, Michael and James Buchholz. 1982. ed. Josselyn, Michael. "Summary of Past Wetland Restoration Projects in California" In: Proceedings of Wetland Restoration and Enhancement in California Workshop. Report No. T-CSGCP-007, Tiburon Center for Environmental Studies, Tiburon, CA. pp. 1-10.

Kleinfelder & Associates. 1983. "Report of Monitoring Well Installation and Embankment Stability Evaluation Chemical and Pigment Company Plant Pittsburg, California," prepared for Chemical and Pigment Company by J. H. Kleinfelder & Associates, Walnut Creek, California.

Kosson, D. S., R. C. Ahlert, J. D. Boyer, E. A. Dienemann, and J. F. Magee, III, 1985. "Development and Application of On-Site Treatment Technologies for Sludge-Filled Lagoons." Proceedings: International Conference on New Frontiers for Hazardous Waste Management, U.S. Environmental Protection Agency, September, 1985.

Lee, C. R., O'Neil, L. J., Brandon, D. L., Rhett, R. G., Sanders, D. R., Skogerboe, J. G., Kay, S. H., Folsom, B. L., Jr., Wakeley, J. S., Roberts, T. H., Saddler, K. M., Kendall, D. R., and Lunz, J. D. 1986. "Remedial Investigation of Contaminant Mobility at Naval Weapons Station, Concord (Final Draft)," US Army Engineer Waterways Experiment Station, Miscellaneous Paper EL-86-2, Vicksburg, MS.

Lee, C. R., L. J. O'Neil, E. J. Clairain, and M. J. Cullinane, Jr. 1985. "Assessment of Damage to Natural Resources at Naval Weapons Station, Concord (Final Draft)," US Army Engineer Waterways Experiment Station, Miscellaneous Paper EL-85- , Vicksburg, MS.

Lee, C. R., O'Neil, L. J., Brandon, D. L., Rhett, R. G., Skogerboe, J. G., Portzer, A. S. and Price, R. A. 1988. "Remedial Investigation of Contaminant Mobility at Naval Weapons Station, Concord, California, Appendix 2.5, 1986/1987 Data," US Army Engineer Waterways Experiment Station, Miscellaneous Paper EL-86-2, Vicksburg, MS.

Lee, C. R., Cullinane, M. J., Jr., and O'Neil, L. J. 1988. "Feasibility Study of Contamination Remediation at Naval Weapons Station, Concord, California, Vol. III: Figures," Draft Final Report, U.S. Army Engineer Waterways Experiment Station, Miscellaneous Paper EL-86-3, Vicksburg, MS.

Lutton, R. J., Bennett, R. D., and McAneny, C. C. 1987. "Suitability of Sites for Hazardous Waste Disposal at Naval Weapons Station, Concord, California," Final Draft Report, U.S. Army Engineer Waterways Experiment Station, Miscellaneous Paper GL-87-28, Vicksburg, Miss.

Morris, J. H. and Newcombe, C. L., 1978. "Habitat Development Field Investigations Salt Pond No. 3, Marsh Development Site South San Francisco Bay, California Summary Report," Technical Report D-78-57, US Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

Nash, James and Richard R. Traver, 1986. "Field Evaluation of In-situ Washing of Contaminated Soils with Water/Surfactants," Land Disposal, Remedial Action, Incineration and Treatment of Hazardous Waste, Proceedings of the Twelfth Annual Research Symposium, U.S. Environmental Protection Agency, August, 1986.

Naval Weapons Station, Concord, California Master Plan October 1979.

Newling, C. J., and Landin, M. C. 1985. "Long-Term Monitoring of Habitat Development at Upland and Wetland Dredged Material Sites, 1974-1982," Technical Report D-85-5, US Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

OH Materials. 1987. Personal communication with Mr. Jim Walker, May 7, 1987.

O'Neil, J. 1988. "Feasibility Study of Contamination Remediation at Naval Weapons Station, Concord, California, Vol. II: Biological Assessment," U.S. Army Engineer Waterways Experiment Station, Miscellaneous Paper EL-86-3 Vicksburg, Miss.

Peddicord, R. K., C. R. Lee, M. R. Palermo, and N. R. Francingues, Jr. 1986. "General Decisionmaking Framework for Management of Dredged Material; Example Application to Commencement Bay, Washington," Miscellaneous Paper D-86- , US Army Engineer Waterways Experiment Station, Vicksburg, MS.

Portland Cement Association, 1964. Handbook of Concrete Culvert Pipe Hydraulics. Skokie, IL. 267 pp.

Regional Water Quality Control Board (RWQCB). 1984. "Waste Discharge Requirements for Allied Corporation Bay Point Works, Pittsburg, Contra Costa County," Order No. 84-84, San Francisco Bay Region.

Regional Water Quality Control Board (RWQCB). 1977. Letter to Fred Nicar, Plant Manager, Allied Chemical, San Francisco Bay Region, 14 March 1977.

Rickabaugh, Janet, Sara Clement, Janette Martin, Mark Sunderhaus, and Ronald F. Lewis, 1986. "Chemical and Microbial Stabilization Techniques for Remedial Action Sites," Land Disposal, Remedial Action, Incineration and Treatment of Hazardous Waste, Proceedings of the Twelfth Annual Research Symposium, U.S. Environmental Protection Agency, August, 1986.

State of California Department of Water Resources. 1981. Rainfall Depth-Duration-Frequency for California. Sacramento, CA. 39 pp.

Tetra Resources. 1988. Personal communication with Mr. Russell Fisher, January 14, 1988.

Tornatore, F. 1988. Personal communication, California Department of Health Services, Toxics, Sacramento, California.

US Army Corps of Engineers. 1984. San Francisco Bay Tidal Stage vs Frequency Study, San Francisco District. 25 pp.

US Dept. of Agriculture Soil Conservation Service. 1978. Soil survey Report. Contra Costa County, Ca.

US Environmental Protection Agency. 1978. "Manual of Treatment Techniques for Meeting the Interim Primary Drinking Water Regulations," EPA-600/8-77-005, Municipal Environmental Research Laboratory, Cincinnati, OH.

US Environmental Protection Agency. 1982. "Handbook-Remedial Action at Waste Disposal Sites," Municipal Environmental Research Laboratory, Cincinnati, OH.

US Environmental Protection Agency. 1983a. "Projecting Future Sea Level Rise," Office of Policy and Resource Management, Washington, D.C.

US Environmental Protection Agency. 1983b. "Handbook for Evaluating Remedial Action Technology Plans," EPA-600/2-83-076, Municipal Environmental Research Laboratory, Cincinnati, OH.

US Environmental Protection Agency. 1984a. "Slurry Trench Construction for Pollution Migration Control," EPA-540/2-84-001, Washington, D.C.

US Environmental Protection Agency. 1984b. "National Oil and Hazardous Substance Pollution Plan," 40 CFR 300 et seq. Washington, D.C.

US Environmental Protection Agency. 1984c. "Review of In-Place Treatment Techniques for Contaminated Surface Soils," EPA-540/2-84-003a, Washington, D.C.

US Environmental Protection Agency. 1985. "Guidance on Feasibility Studies Under CERCLA," EPA/540/G-85/003, Washington, D.C.

US Environmental Protection Agency. 1986a. "Handbook for Stabilization/ Solidification of Hazardous Wastes," EPA/540/2-86/001, Hazardous Waste Engineering Research Laboratory, Cincinnati, OH.

US Environmental Protection Agency. 1986b. "Mobile Treatment Technologies for Superfund Wastes," EPA 540/2-86/003(f), Office of Solid Waste and Emergency and Office of Emergency and Remedial Response, Washington, D.C.

US Environmental Protection Agency. 1986c. Quality Criteria for Water: 1986," EPA 440/5-86-001, Office of Water Regulations and Standards, Washington, D.C.

US Environmental Protection Agency. 1987a. "Interim Guidance on Compliance with Applicable or Relevant and Appropriate Requirements," Office of Solid Waste and Emergency Response, Washington, D.C.

US Environmental Protection Agency. 1987b. "CERCLA Compliance with Other Laws Manual," Draft Dated January 30, 1987, OSWER Directive 9234.0-3, Office of Solid Waste and Emergency Response, Washington, D.C.

US Environmental Protection Agency. 1987c. Personal communication with Mr. Frank Freestone.

US Navy. 1987. "Conceptual Plans for Additional Investigation of Potential Surface Water and Groundwater Contamination on Parcels 571, 572, 573, 574, 575, 576, 579D, and 581 on the Naval Weapons Station, Concord, California," Department of the Navy submitted to the State of California Regional Water Quality Control Board, 5 October 1987, Naval Facilities Engineering Command, San Bruno, CA.

Waananen, A. O. and J. R. Crippen. 1977. "Magnitude and Frequency of Flood in California." US Geological Survey, Water Resources Investigations 77-221. Menlo Park, CA. 96 pp.

Wetzel, Roger S., Donald H. Davidson, Connie M. Durst and Douglas J. Sarno, 1986. "Field Demonstration of In-situ Biological Treatment of Contaminated Groundwater and Soils," Land Disposal, Remedial Action, Incineration and Treatment of Hazardous Waste, Proceedings of the Twelfth Annual Research Symposium, U.S. Environmental Protection Agency, August, 1986.

Zedler, J. B. 1984. "Salt Marsh Restoration: A Guidebook for Southern California," California Sea Grant Report No. T-CSGCP-009, California Sea Grant College Program, University of California A-032, La Jolla, CA.

APPENDIX A: ESTIMATED QUANTITY CALCULATIONS FOR ALTERNATIVE REMEDIAL ACTIONS

Table A.1

Estimated Quantities for Implementation of Alternative 1-1

Item Number	Item Description	Unit of Measure	Quantity
1	Develop Notification Plan	LS	1
2	Property Record Review and Annotation	LS	1
3	Property Posting	LS	1

LS: Lump Sum

Table A.2

Estimated Quantities for Implementation of Alternative 1-2

Item Number	Item Description	Unit of Measure	Quantity
1	Property Record Review and Annotation	LS	1
2	Develop Notification Plan	LS	1
3	Property Posting	LS	1
4	Detailed Sampling and Analysis Plan	LS	1
5	Action Level and Response Plan	LS	1

LS: Lump Sum

Table A.3

Estimated Quantities for Implementation of Alternative 1-3A[1]

Item Number	Item Description	Unit of Measure	Quantity
1	Support Facilities	LS	1
2	Site Preparation	LS	1
3	Excavation Class I	CY	14568
4	Materials Classification[2] Facility	LS	1
5	Backfilling	CY	17482
6	Transportation Class I	CY	20396
7	Disposal Class I	CY	20396
8	Final Grading	SY	52468
9	Wetland Restoration	SY	52468

LS: Lump Sum SY: Square Yard CY: Cubic Yard

1 Based on active and passive remediation areas presented in Table 3.24.

2 If proven economical during concept design, materials will be classified for separate disposal.

Table A.4

Estimated Quantities for Implementation of Alternative 1-3C[1]

Item Number	Item Description	Unit of Measure	Quantity
1	Support Facilities	LS	1
2	Site Preparation	LS	1
3	Excavation Class I	CY	14568
4	Materials Classification Facility[2]	LS	1
5	Backfilling	CY	17482
6	Immobilization Laboratory/ Pilot Study	LS	1
7	Chemical Immobilization Facility	LS	1
8	Stabilization of Materials	CY	20396
9	Transportation Class III[3]	CY	26514
10	Disposal Class III[3]	CY	26514
11	Final Grading	SY	52468
12	Wetland Restoration	SY	52468

LS: Lump Sum SY: Square Yard CY: Cubic Yard

1 Based on active and passive remediation areas presented in Table 3.24.

2 If proven economical during concept design, materials will be classified for separate disposal.

3 Assumes that the chemical stabilization/solidification process will increase the volume by 30 percent.

Table A.5

Estimated Quantities for Implementation of Alternative 1-3D[1]

Item Number	Item Description	Unit of Measure	Quantity
1	Support Facilities	LS	1
2	Site Preparation	LS	1
3	Excavation Class I	CY	14568
4	Materials Classification Facility[2]	LS	1
5	Backfilling	CY	17482
6	Immobilization Laboratory/ Pilot Study	LS	1
7	Chemical Immobilization Facility	LS	1
8	Stabilization of Materials	CY	20396
9	Transportation Class III[3]	CY	26514
10	Monofill Disposal Class I[3]	CY	26514
11	Final Grading	SY	52468
12	Wetland Restoration	SY	52468

LS: Lump Sum SY: Square Yard CY: Cubic Yard

1 Based on active and passive remediation areas presented in Table 3.24.

2 If proven economical during concept design, materials will be classified for separate disposal.

3 Assumes that the chemical stabilization/solidification process will increase the volume by 30 percent.

Table A.6

Estimated Quantities for Implementation of Alternative 1-3E[1]

Item Number	Item Description	Unit of Measure	Quantity
1	Support Facilities	LS	1
2	Site Preparation	LS	1
3	Excavation Class I	CY	14568
4	Materials Classification Facility[2]	LS	1
5	Backfilling	CY	17482
6	Soil Washing Laboratory/ Pilot Study	LS	1
7	Soil Washing Facility	LS	1
8	Soil Washing	CY	14568
9	Transportation Class I[3]	CY	2913
10	Transportation Class III[3]	CY	20396
11	Disposal Class I(RCRA)[3]	CY	2913
12	Disposal Class III[3]	CY	20396
13	Final Grading	SY	52468
14	Wetland Restoration	SY	52468

LS: Lump Sum SY: Square Yard CY: Cubic Yard

1 Based on active and passive remediation areas presented in Table 3.24.

2 If proven economical during concept design, materials will be classified for separate disposal.

3 Assumes that the soil washing process will produce a sludge with 20 percent of the volume of treated soil.

Table A.7

Estimated Quantities for Implementation of Alternative 1-3F[1]

Item Number	Item Description	Unit of Measure	Quantity
1	Support Facilities	LS	1
2	Site Preparation	LS	1
3	Excavation Class I	CY	14568
4	Materials Classification Facility[2]	LS	1
5	Backfilling	CY	17482
6	Soil Washing Laboratory/ Pilot Study	LS	1
7	Soil Washing Facility	LS	1
8	Soil Washing	CY	14568
9	Transportation Class I[3]	CY	2913
10	Transportation Class III[3]	CY	20396
11	Disposal Class I(RCRA)[3]	CY	2913
12	Monofill Disposal Class III[3]	CY	20396
13	Final Grading	SY	52468
14	Wetland Restoration	SY	52468

LS: Lump Sum SY: Square Yard CY: Cubic Yard

1 Based on active and passive remediation areas presented in Table 3.24.

2 If proven economical during concept design, materials will be classified for separate disposal.

3 Assumes that the soil washing process will produce a sludge with 20 percent of the volume of treated soil.

Table A.8

Estimated Quantities for Implementation of Alternative 2-1

Item Number	Item Description	Unit of Measure	Quantity
1	Develop Notification Plan	LS	1
2	Property Record Review and Annotation	LS	1
3	Property Posting	LS	1

LS: Lump Sum

Table A.9

Estimated Quantities for Implementation of Alternative 2-2

Item Number	Item Description	Unit of Measure	Quantity
1	Property Record Review and Annotation	LS	1
2	Develop Notification Plan	LS	1
3	Property Posting	LS	1
4	Detailed Sampling and Analysis Plan	LS	1
5	Action Level and Response Plan	LS	1

LS: Lump Sum

Table A.10

Estimated Quantities for Implementation of Alternative 2-3A[1]

Item Number	Item Description	Unit of Measure	Quantity
1	Support Facilities	LS	1
2	Site Preparation	LS	1
3	Excavation Class I (Dry)	CY	3421
4	Excavation Class I (Wet)	CY	5373
5	Excavation Class III[2]	CY	678
6	Materials Classification Facility[2]	LS	1
7	Backfilling	CY	11365
8	Transportation Class I	CY	12310
9	Transportation Class III[2]	CY	949
10	Disposal Class I	CY	12310
11	Disposal Class III[2]	CY	949
12	Final Grading	SY	26265
13	Wetland Restoration	SY	26265

LS: Lump Sum SY: Square Yard CY: Cubic Yard

1 Based on active and passive remediation areas presented in Table 3.24.

2 If proven economical during concept design, materials will be classified for separate disposal.

Table A.11

Estimated Quantities for Implementation of Alternative 2-3C[1]

Item Number	Item Description	Unit of Measure	Quantity
1	Support Facilities	LS	1
2	Site Preparation	LS	1
3	Excavation Class I (Dry)	CY	3421
4	Excavation Class I (Wet)	CY	5373
5	Excavation Class III[2]	CY	678
6	Materials Classification[2] Facility	LS	1
7	Backfilling	CY	11365
8	Immobilization Laboratory/ Pilot Study	LS	1
9	Chemical Immobilization Facility	LS	1
10	Stabilization of Materials	CY	12310
11	Transportation Class III[3]	CY	16952
12	Disposal Class III[3]	CY	16952
13	Final Grading	SY	26265
14	Wetland Restoration	SY	26265

LS: Lump Sum SY: Square Yard CY: Cubic Yard

1 Based on active and passive remediation areas presented in Table 3.24.

2 If proven economical during concept design, materials will be classified for separate disposal.

3 Assumes that the chemical stabilization/solidification process will increase the volume by 30 percent.

Table A.12

Estimated Quantities for Implementation of Alternative 2-3D[1]

Item Number	Item Description	Unit of Measure	Quantity
1	Support Facilities	LS	1
2	Site Preparation	LS	1
3	Excavation Class I (Dry)	CY	3421
4	Excavation Class I (Wet)	CY	5373
5	Excavation Class III[2]	CY	678
6	Materials Classification Facility[2]	LS	1
7	Backfilling	CY	11365
8	Immobilization Laboratory/ Pilot Study	LS	1
9	Chemical Immobilization Facility	LS	1
10	Stabilization of Materials	CY	12310
11	Transportation Class III[3]	CY	16952
12	Monofill Disposal Class I	CY	16952
13	Final Grading	SY	26265
14	Wetland Restoration	SY	26265

LS: Lump Sum SY: Square Yard CY: Cubic Yard

1 Based on active and passive remediation areas presented in Table 3.24.

2 If proven economical during concept design, materials will be classified for separate disposal.

3 Assumes that the chemical stabilization/solidification process will increase the volume by 30 percent.

Table A.13

Estimated Quantities for Implementation of Alternative 2-3E[1]

Item Number	Item Description	Unit of Measure	Quantity
1	Support Facilities	LS	1
2	Site Preparation	LS	1
3	Excavation Class I (Dry)	CY	3421
4	Excavation Class I (Wet)	CY	5373
5	Excavation Class III[2]	CY	678
6	Materials Classification Facility[2]	LS	1
7	Backfilling	CY	11365
8	Soil Washing Laboratory/ Pilot Study	LS	1
9	Soil Washing Facility	LS	1
10	Soil Washing	CY	8793
11	Transportation Class I	CY	1759
12	Transportation Class III[3]	CY	13259
13	Disposal Class I (RCRA)	CY	1759
14	Disposal Class III[3]	CY	13259
15	Final Grading	SY	26265
16	Wetland Restoration	SY	26265

LS: Lump Sum SY: Square Yard CY: Cubic Yard

1 Based on active and passive remediation areas presented in Table 3.24.

2 If proven economical during concept design, materials will be classified for separate disposal.

3 Assumes that the soil washing process will produce a sludge with 20 percent of the volume of treated soil.

Table A.14

Estimated Quantities for Implementation of Alternative 2-3F[1]

Item Number	Item Description	Unit of Measure	Quantity
1	Support Facilities	LS	1
2	Site Preparation	LS	1
3	Excavation Class I (Dry)	CY	3421
4	Excavation Class I (Wet)	CY	5373
5	Excavation Class III[2]	CY	678
6	Materials Classification Facility[2]	LS	1
7	Backfilling	CY	11365
8	Soil Washing Laboratory/ Pilot Study	LS	1
9	Soil Washing Facility	LS	1
10	Soil Washing	CY	8793
11	Transportation Class I	CY	1759
12	Transportation Class III[3]	CY	13259
13	Disposal Class I (RCRA)	CY	1759
14	Monofill Disposal Class III[3]	CY	13259
15	Final Grading	SY	26265
16	Wetland Restoration	SY	26265

LS: Lump Sum SY: Square Yard CY: Cubic Yard

1 Based on active and passive remediation areas presented in Table 3.24.

2 If proven economical during concept design, materials will be classified for separate disposal.

3 Assumes that the soil washing process will produce a sludge with 20 percent of the volume of treated soil.

Table A.15

Estimated Quantities for Implementation of Alternative 3-1

Item Number	Item Description	Unit of Measure	Quantity
1	Develop Notification Plan	LS	1
2	Property Record Review and Annotation	LS	1
3	Property Posting	LS	1

LS: Lump Sum

Table A.16

Estimated Quantities for Implementation of Alternative 3-2

Item Number	Item Description	Unit of Measure	Quantity
1	Property Record Review and Annotation	LS	1
2	Develop Notification Plan	LS	1
3	Property Posting	LS	1
4	Detailed Sampling and Analysis Plan	LS	1
5	Action Level and Response Plan	LS	1

LS: Lump Sum

Table A.17

Estimated Quantities for Implementation of Alternative 3-3A[1]

Item Number	Item Description	Unit of Measure	Quantity
1	Support Facilities	LS	1
2	Site Preparation	LS	1
3	Excavation Class I (Dry)	CY	1388
4	Excavation Class I (Wet)	CY	1711
5	Excavation Class III[2]	CY	4421
6	Materials Classification Facility[2]	LS	1
7	Backfilling	CY	9022
8	Transportation Class I	CY	4337
9	Transportation Class III[2]	CY	6189
10	Disposal Class I (Non RCRA)	CY	4337
11	Disposal Class III[2]	CY	6189
12	Final Grading	SY	28962
13	Wetland Restoration	SY	28962

LS: Lump Sum SY: Square Yard CY: Cubic Yard

1 Based on active and passive remediation areas presented in Table 3.24.

2 If proven economical during concept design, materials will be classified for separate disposal.

Table A.18

Estimated Quantities for Implementation of Alternative 3-3C[1]

Item Number	Item Description	Unit of Measure	Quantity
1	Support Facilities	LS	1
2	Site Preparation	LS	1
3	Excavation Class I (Dry)	CY	1388
4	Excavation Class I (Wet)	CY	1711
5	Excavation Class III[2]	CY	4421
6	Materials Classification Facility[2]	LS	1
7	Backfilling	CY	9022
8	Immobilization Laboratory/ Pilot Study	LS	1
9	Chemical Immobilization Facility	LS	1
10	Stabilization of Materials	CY	4337
11	Transportation Class III[3]	CY	11828
12	Disposal Class III[3]	CY	11828
13	Final Grading	SY	28962
14	Wetland Restoration	SY	28962

LS: Lump Sum SY: Square Yard CY: Cubic Yard

1 Based on active and passive remediation areas presented in Table 3.24.

2 If proven economical during concept design, materials will be classified for separate disposal.

3 Assumes that the chemical stabilization/solidification process will increase the volume by 30 percent.

Table A.19

Estimated Quantities for Implementation of Alternative 3-3D[1]

Item Number	Item Description	Unit of Measure	Quantity
1	Support Facilities	LS	1
2	Site Preparation	LS	1
3	Excavation Class I (Dry)	CY	1388
4	Excavation Class I (Wet)	CY	1711
5	Excavation Class III[2]	CY	4421
6	Materials Classification[2] Facility	LS	1
7	Backfilling	CY	9022
8	Immobilization Laboratory/ Pilot Study	LS	1
9	Chemical Immobilization Facility	LS	1
10	Stabilization of Materials	CY	4337
11	Transportation Class III[3]	CY	11828
12	Monofill Disposal Class I	CY	11828
13	Final Grading	SY	28962
14	Wetland Restoration	SY	28962

LS: Lump Sum SY: Square Yard CY: Cubic Yard

1 Based on active and passive remediation areas presented in Table 3.24.

2 If proven economical during concept design, materials will be classified for separate disposal.

3 Assumes that the chemical stabilization/solidification process will increase the volume by 30 percent.

Table A.20

Estimated Quantities for Implementation of Alternative 3-3E[1]

Item Number	Item Description	Unit of Measure	Quantity
1	Support Facilities	LS	1
2	Site Preparation	LS	1
3	Excavation Class I (Dry)	CY	1388
4	Excavation Class I (Wet)	CY	1711
5	Excavation Class III[2]	CY	4421
6	Materials Classification Facility[2]	LS	1
7	Backfilling	CY	9022
8	Soil Washing Laboratory/ Pilot Study	LS	1
9	Soil Washing Facility	LS	1
10	Soil Washing	CY	3098
11	Transportation Class I	CY	620
12	Transportation Class III[3]	CY	10527
13	Disposal Class I (RCRA)	CY	620
14	Disposal Class III[3]	CY	10527
15	Final Grading	SY	28962
16	Wetland Restoration	SY	28962

LS: Lump Sum SY: Square Yard CY: Cubic Yard

1 Based on active and passive remediation areas presented in Table 3.24.

2 If proven economical during concept design, materials will be classified for separate disposal.

3 Assumes that the soil washing process will produce a sludge with 20 percent of the volume of treated soil.

Table A.21

Estimated Quantities for Implementation of Alternative 3-3F[1]

Item Number	Item Description	Unit of Measure	Quantity
1	Support Facilities	LS	1
2	Site Preparation	LS	1
3	Excavation Class I (Dry)	CY	1388
4	Excavation Class I (Wet)	CY	1711
5	Excavation Class III[2]	CY	4421
6	Materials Classification[2] Facility	LS	1
7	Backfilling	CY	9022
8	Soil Washing Laboratory/ Pilot Study	LS	1
9	Soil Washing Facility	LS	1
10	Soil Washing	CY	3098
11	Transportation Class I	CY	620
12	Transportation Class III[3]	CY	10527
13	Disposal Class I (RCRA)	CY	620
14	Monofill Disposal Class III[3]	CY	10527
15	Final Grading	SY	28962
16	Wetland Restoration	SY	28962

LS: Lump Sum SY: Square Yard CY: Cubic Yard

1 Based on active and passive remediation areas presented in Table 3.24.

2 If proven economical during concept design, materials will be classified for separate disposal.

3 Assumes that the soil washing process will produce a sludge with 20 percent of the volume of treated soil.

Table A.22

Estimated Quantities for Implementation of Alternative 4-1

Item Number	Item Description	Unit of Measure	Quantity
1	Develop Notification Plan	LS	1
2	Property Record Review and Annotation	LS	1
3	Property Posting	LS	1

LS: Lump Sum

Table A.23

Estimated Quantities for Implementation of Alternative 4-2

Item Number	Item Description	Unit of Measure	Quantity
1	Property Record Review and Annotation	LS	1
2	Develop Notification Plan	LS	1
3	Property Posting	LS	1
4	Detailed Sampling and Analysis Plan	LS	1
5	Action Level and Response Plan	LS	1

LS: Lump Sum

Table A.24

Estimated Quantities for Implementation of Alternative 4-3A[1]

Item Number	Item Description	Unit of Measure	Quantity
1	Support Facilities	LS	1
2	Site Preparation	LS	1
3	Excavation Class I	CY	903
4	Materials Classification[2] Facility	LS	1
5	Backfilling	CY	1684
6	Transportation Class I	CY	1265
7	Disposal Class I	CY	1265
8	Final Grading	SY	7206
9	Wetland Restoration	SY	7206
10	Liming	SY	1500

LS: Lump Sum SY: Square Yard CY: Cubic Yard

1 Based on active and passive remediation areas presented in Table 3.24.

2 If proven economical during concept design, materials will be classified for separate disposal.

Table A.25

Estimated Quantities for Implementation of Alternative 4-3C[1]

Item Number	Item Description	Unit of Measure	Quantity
1	Support Facilities	LS	1
2	Site Preparation	LS	1
3	Excavation Class I	CY	903
4	Materials Classification Facility[2]	LS	1
5	Backfilling	CY	1684
6	Immobilization Laboratory/ Pilot Study	LS	1
7	Chemical Immobilization Facility	LS	1
8	Stabilization of Materials	CY	1265
9	Transportation Class III	CY	1645
10	Disposal Class III	CY	1645
11	Final Grading	SY	7206
12	Wetland Restoration	SY	7206
13	Liming	SY	1500

LS: Lump Sum SY: Square Yard CY: Cubic Yard

1 Based on active and passive remediation areas presented in Table 3.24.

2 If proven economical during concept design, materials will be classified for separate disposal.

Table A.26

Estimated Quantities for Implementation of Alternative 4-3D[1]

Item Number	Item Description	Unit of Measure	Quantity
1	Support Facilities	LS	1
2	Site Preparation	LS	1
3	Excavation Class I	CY	903
4	Materials Classification Facility[2]	LS	1
5	Backfilling	CY	1684
6	Immobilization Laboratory/ Pilot Study	LS	1
7	Chemical Immobilization Facility	LS	1
8	Stabilization of Materials	CY	1265
9	Transportation Class III	CY	1645
10	Monofill Disposal Class I	CY	1645
11	Final Grading	SY	7206
12	Wetland Restoration	SY	7206
13	Liming	SY	1500

LS: Lump Sum SY: Square Yard CY: Cubic Yard

1 Based on active and passive remediation areas presented in Table 3.24.

2 If proven economical during concept design, materials will be classified for separate disposal.

Table A.27

Estimated Quantities for Implementation of Alternative 4-3E[1]

Item Number	Item Description	Unit of Measure	Quantity
1	Support Facilities	LS	1
2	Site Preparation	LS	1
3	Excavation Class I	CY	903
4	Materials Classification[2] Facility	LS	1
5	Backfilling	CY	1684
6	Soil Washing Laboratory/ Pilot Study	LS	1
7	Soil Washing Facility	LS	1
8	Soil Washing	CY	903
9	Transportation Class I[3]	CY	181
10	Transportation Class III	CY	1265
11	Disposal Class I[3] (RCRA)	CY	181
12	Disposal Class III	CY	1265
13	Final Grading	SY	7206
14	Wetland Restoration	SY	7206
15	Liming	SY	1500

LS: Lump Sum SY: Square Yard CY: Cubic Yard

1 Based on active and passive remediation areas presented in Table 3.24.

2 If proven economical during concept design, materials will be classified for separate disposal.

3 Assumes that the soil washing process will produce a sludge with 20 percent of the volume of treated soil.

Table A.28

Estimated Quantities for Implementation of Alternative 4-3F[1]

Item Number	Item Description	Unit of Measure	Quantity
1	Support Facilities	LS	1
2	Site Preparation	LS	1
3	Excavation Class I	CY	903
4	Materials Classification[2] Facility	LS	1
5	Backfilling	CY	1684
6	Soil Washing Laboratory/ Pilot Study	LS	1
7	Soil Washing Facility	LS	1
8	Soil Washing	CY	903
9	Transportation Class I[3]	CY	181
10	Transportation Class III	CY	1265
11	Disposal Class I[3] (RCRA)	CY	181
12	Monofill Disposal Class III	CY	1265
13	Final Grading	SY	7206
14	Wetland Restoration	SY	7206
15	Liming	SY	1500

LS: Lump Sum SY: Square Yard CY: Cubic Yard

1 Based on active and passive remediation areas presented in Table 3.24.

2 If proven economical during concept design, materials will be classified for separate disposal.

3 Assumes that the soil washing process will produce a sludge with 20 percent of the volume of treated soil.

Table A.29

Estimated Quantities for Implementation of Alternative 4-4A[1]

Item Number	Item Description	Unit of Measure	Quantity
1	Support Facilities	LS	1
2	Site Preparation	LS	1
3	Initial Site Grading	SY	7206
4	Clean Fill Cover	CY	6388
5	Top Soil Cover	CY	6388
6	Final Grading	SY	7206
7	Revegetation	SY	7206
8	Liming	SY	1500

LS: Lump Sum SY: Square Yard CY: Cubic Yard

1 Based on active and passive remediation areas presented in Table 3.24.

Table A.30

Estimated Quantities for Implementation of Alternative 4-4B[1]

Item Number	Item Description	Unit of Measure	Quantity
1	Support Facilities	LS	1
2	Site Preparation	LS	1
3	Initial Site Grading	SY	7206
4	Clean Fill Cover	CY	6388
5	RCRA Cover	SY	7206
6	Final Grading	SY	7206
7	Revegetation	SY	7206
8	Liming	SY	1500

LS: Lump Sum SY: Square Yard CY: Cubic Yard

1 Based on active and passive remediation areas presented in Table 3.24.

APPENDIX B: ESTIMATED CAPITAL COSTS FOR ALTERNATIVE REMEDIAL ACTIONS

Table B.1

Estimated Capital Cost for Implementation of Alternative 1-1

Item Number	Item Description	Unit Of Measure	Unit Cost	Quantity	Cost (000$)
1	Develop Notification Plan	LS	17000	1	17
2	Property Record Review and Annotation	LS	10000	1	10
3	Property Posting	LS	6000	1	6
4	Subtotal Construction Cost				33
5	Mobilization (10%)				4
6	Engineering (15%)				5
7	Contingencies (25%)				9
8	Total Project Cost				51

Table B.2

Estimated Capital Cost for Implementation of Alternative 1-2

Item Number	Item Description	Unit Of Measure	Unit Cost	Quantity	Cost (000$)
1	Property Record Review and Annotation	LS	10000	1	10
2	Develop Notification Plan	LS	17000	1	17
3	Property Posting	LS	6000	1	6
4	Detailed Sampling and Analysis Plan	LS	17000	1	17
5	Action Level and Response Plan	LS	64000	1	64
6	Subtotal Construction Cost				114
7	Mobilization (10%)				12
8	Engineering (15%)				18
9	Contingencies (25%)				29
10	Total Project Cost				173

Table B.3

Estimated Capital Cost for Implementation of Alternative 1-3A

Item Number	Item Description	Unit Of Measure	Unit Cost	Quantity	Cost (000$)
1	Support Facilities	LS	65000	1	65
2	Site Preparation	LS	67000	1	67
3	Excavation Class I	CY	10	14568	146
4	Materials Classification Facility	LS	43000	1	43
5	Backfilling	CY	23	17482	403
6	Transportation Class I	CY	50	20396	1020
7	Disposal Class I (Non RCRA)	CY	157	20396	3202
8	Final Grading	SY	1	52468	53
9	Wetland Restoration	SY	3	52468	158
10	Subtotal Construction Cost				5157
11	Mobilization (10%)				516
12	Engineering (15%)				774
13	Contingencies (25%)				1290
14	Total Project Cost				7737

Table B.4

Estimated Capital Cost for Implementation of Alternative 1-3C

Item Number	Item Description	Unit Of Measure	Unit Cost	Quantity	Cost (000$)
1	Support Facilities	LS	65000	1	65
2	Site Preparation	LS	67000	1	67
3	Excavation Class I	CY	10	14568	146
4	Materials Classification Facility	LS	43000	1	43
5	Backfilling	CY	23	17482	403
6	Immobilization Laboratory/ Pilot Study	LS	100000	1	100
7	Chemical Immobilization Facility	LS	40000	1	40
8	Stabilization of Materials	CY	46	20396	939
9	Transportation Class III	CY	10	26514	266
10	Disposal Class III	CY	20	26514	531
11	Final Grading	SY	1	52468	53
12	Wetland Restoration	SY	3	52468	158
13	Subtotal Construction Cost				3076
14	Mobilization (10%)				308
15	Engineering (15%)				462
16	Contingencies (25%)				769
17	Total Project Cost				4615

Table B.5

Estimated Capital Cost for Implementation of Alternative 1-3D

Item Number	Item Description	Unit Of Measure	Unit Cost	Quantity	Cost (000$)
1	Support Facilities	LS	65000	1	65
2	Site Preparation	LS	67000	1	67
3	Excavation Class I	CY	10	14568	146
4	Materials Classification Facility	LS	43000	1	43
5	Backfilling	CY	23	17482	403
6	Immobilization Laboratory/ Pilot Study	LS	100000	1	100
7	Chemical Immobilization Facility	LS	40000	1	40
8	Stabilization of Materials	CY	46	20396	939
9	Transportation Class III	CY	15	26514	398
10	Monofill Disposal Class I	CY	30	26514	796
11	Final Grading	SY	1	52468	53
12	Wetland Restoration	SY	3	52468	158
13	Subtotal Construction Cost				3208
14	Mobilization (10%)				321
15	Engineering (15%)				482
16	Contingencies (25%)				802
17	Total Project Cost				4812

Table B.6

Estimated Capital Cost for Implementation of Alternative 1-3E

Item Number	Item Description	Unit Of Measure	Unit Cost	Quantity	Cost (000$)
1	Support Facilities	LS	65000	1	65
2	Site Preparation	LS	67000	1	67
3	Excavation Class I	CY	10	14568	146
4	Materials Classification Facility	LS	43000	1	43
5	Backfilling	CY	23	17482	403
6	Soil Washing Laboratory/ Pilot Study	LS	200000	1	200
7	Soil Washing Facility	LS	40000	1	40
8	Soil Washing	CY	200	14568	2914
9	Transportation Class I	CY	50	2913	146
10	Transportation Class III	CY	15	20396	306
11	Disposal Class I	CY	239	2913	697
12	Disposal Class III	CY	20	20396	408
13	Final Grading	SY	1	52468	53
14	Wetland Restoration	SY	3	52468	158
15	Subtotal Construction Cost				5643
16	Mobilization (10%)				565
17	Engineering (15%)				847
18	Contingencies (25%)				1411
19	Total Project Cost				8465

Table B.7

Estimated Capital Cost for Implementation of Alternative 1-3F

Item Number	Item Description	Unit Of Measure	Unit Cost	Quantity	Cost (000$)
1	Support Facilities	LS	65000	1	65
2	Site Preparation	LS	67000	1	67
3	Excavation Class I	CY	10	14568	146
4	Materials Classification Facility	LS	43000	1	43
5	Backfilling	CY	23	17482	403
6	Soil Washing Laboratory/ Pilot Study	LS	200000	1	200
7	Soil Washing Facility	LS	40000	1	40
8	Soil Washing	CY	200	14568	2914
9	Transportation Class I	CY	50	2913	146
10	Transportation Class III	CY	10	20396	204
11	Disposal Class I	CY	239	2913	697
12	Monofill Disposal Class III	CY	18	20396	368
13	Final Grading	SY	1	52468	53
14	Wetland Restoration	SY	3	52468	158
15	Subtotal Construction Cost				5504
16	Mobilization (10%)				551
17	Engineering (15%)				826
18	Contingencies (25%)				1376
19	Total Project Cost				8257

Table B.8

Estimated Capital Cost for Implementation of Alternative 2-1

Item Number	Item Description	Unit Of Measure	Unit Cost	Quantity	Cost (000$)
1	Develop Notification Plan	LS	6000	1	6
2	Property Record Review and Annotation	LS	3000	1	3
3	Property Posting	LS	3000	1	3
4	Subtotal Construction Cost				12
5	Mobilization (10%)				2
6	Engineering (15%)				2
7	Contingencies (25%)				3
8	Total Project Cost				19

Table B.9

Estimated Capital Cost for Implementation of Alternative 2-2

Item Number	Item Description	Unit Of Measure	Unit Cost	Quantity	Cost (000$)
1	Property Record Review and Annotation	LS	3000	1	3
2	Develop Notification Plan	LS	6000	1	6
3	Property Posting	LS	3000	1	3
4	Detailed Sampling and Analysis Plan	LS	10000	1	10
5	Action Level and Response Plan	LS	30000	1	30
6	Subtotal Construction Cost				52
7	Mobilization (10%)				6
8	Engineering (15%)				8
9	Contingencies (25%)				13
10	Total Project Cost				79

Table B.10

Estimated Capital Cost for Implementation of Alternative 2-3A

Item Number	Item Description	Unit Of Measure	Unit Cost	Quantity	Cost (000$)
1	Support Facilities	LS	65000	1	65
2	Site Preparation	LS	18000	1	18
3	Excavation Class I (Dry)	CY	5	3421	18
4	Excavation Class I (Wet)	CY	10	5373	54
5	Excavation Class III	CY	4	678	3
6	Materials Classification Facility	LS	43000	1	43
7	Backfilling	CY	23	11365	262
8	Transportation Class I	CY	50	12310	616
9	Transportation Class III	CY	15	949	15
10	Disposal Class I (Non RCRA)	CY	157	12310	1933
11	Disposal Class III	CY	20	949	19
12	Final Grading	SY	1	26265	27
13	Wetland Restoration	SY	3	26265	79
14	Subtotal Construction Cost				3152
15	Mobilization (10%)				316
16	Engineering (15%)				473
17	Contingencies (25%)				788
18	Total Project Cost				4729

Table B.11

Estimated Capital Cost for Implementation of Alternative 2-3C

Item Number	Item Description	Unit Of Measure	Unit Cost	Quantity	Cost (000$)
1	Support Facilities	LS	65000	1	65
2	Site Preparation	LS	18000	1	18
3	Excavation Class I (Dry)	CY	5	3421	18
4	Excavation Class I (Wet)	CY	10	5373	54
5	Excavation Class III	CY	4	678	3
6	Materials Classification Facility	LS	43000	1	43
7	Backfilling	CY	23	11365	262
8	Immobilization Laboratory/ Pilot Study	LS	100000	1	100
9	Chemical Immobilization Facility	LS	40000	1	40
10	Stabilization of Materials	CY	46	12310	396
11	Transportation Class III	CY	15	16952	255
12	Disposal Class III	CY	20	16952	339
13	Final Grading	SY	1	26265	27
14	Wetland Restoration	SY	3	26265	79
15	Subtotal Construction Cost				1699
16	Mobilization (10%)				170
17	Engineering (15%)				255
18	Contingencies (25%)				425
19	Total Project Cost				2549

Table B.12

Estimated Capital Cost for Implementation of Alternative 2-3D

Item Number	Item Description	Unit Of Measure	Unit Cost	Quantity	Cost (000$)
1	Support Facilities	LS	65000	1	65
2	Site Preparation	LS	18000	1	18
3	Excavation Class I (Dry)	CY	5	3421	18
4	Excavation Class I (Wet)	CY	10	5373	54
5	Excavation Class III	CY	4	678	3
6	Materials Classification Facility	LS	43000	1	43
7	Backfilling	CY	23	11365	262
8	Immobilization Laboratory/ Pilot Study	LS	100000	1	100
9	Chemical Immobilization Facility	LS	40000	1	40
10	Stabilization of Materials	CY	46	12310	567
11	Transportation Class III	CY	10	16952	170
12	Monofill Disposal Class I	CY	30	16952	509
13	Final Grading	SY	1	26265	27
14	Wetland Restoration	SY	3	26265	79
15	Subtotal Construction Cost				1955
16	Mobilization (10%)				196
17	Engineering (15%)				294
18	Contingencies (25%)				489
19	Total Project Cost				2934

Table B.13

Estimated Capital Cost for Implementation of Alternative 2-3E

Item Number	Item Description	Unit Of Measure	Unit Cost	Quantity	Cost (000$)
1	Support Facilities	LS	65000	1	65
2	Site Preparation	LS	18000	1	18
3	Excavation Class I (Dry)	CY	5	3421	18
4	Excavation Class I (Wet)	CY	10	5373	54
5	Excavation Class III	CY	4	678	3
6	Materials Classification Facility	LS	43000	1	43
7	Backfilling	CY	23	11365	262
8	Soil Washing Laboratory/ Pilot Study	LS	200000	1	200
9	Soil Washing Facility	LS	40000	1	40
10	Soil Washing	CY	200	8793	1759
11	Transportation Class I	CY	50	1759	88
12	Transportation Class III	CY	15	13259	142
13	Disposal Class I (RCRA)	CY	239	1759	421
14	Disposal Class III	CY	20	13259	266
15	Final Grading	SY	1	26265	27
16	Wetland Restoration	SY	3	26265	79
17	Subtotal Construction Cost				3542
18	Mobilization (10%)				355
19	Engineering (15%)				532
20	Contingencies (25%)				886
21	Total Project Cost				5315

Table B.14

Estimated Capital Cost for Implementation of Alternative 2-3F

Item Number	Item Description	Unit Of Measure	Unit Cost	Quantity	Cost (000$)
1	Support Facilities	LS	65000	1	65
2	Site Preparation	LS	18000	1	18
3	Excavation Class I (Dry)	CY	5	3421	18
4	Excavation Class I (Wet)	CY	10	5373	54
5	Excavation Class III	CY	4	678	3
6	Materials Classification Facility	LS	43000	1	43
7	Backfilling	CY	23	11365	262
8	Soil Washing Laboratory/ Pilot Study	LS	200000	1	200
9	Soil Washing Facility	LS	40000	1	40
10	Soil Washing	CY	200	8793	1759
11	Transportation Class I	CY	50	1759	88
12	Transportation Class III	CY	10	13259	133
13	Disposal Class I (RCRA)	CY	239	1759	421
14	Monofill Disposal Class III	CY	18	13259	239
15	Final Grading	SY	1	26265	27
16	Wetland Restoration	SY	3	26265	79
17	Subtotal Construction Cost				3449
18	Mobilization (10%)				345
19	Engineering (15%)				518
20	Contingencies (25%)				863
21	Total Project Cost				5175

Table B.15

Estimated Capital Cost for Implementation of Alternative 3-1

Item Number	Item Description	Unit Of Measure	Unit Cost	Quantity	Cost (000$)
1	Develop Notification Plan	LS	8000	1	8
2	Property Record Review and Annotation	LS	5000	1	5
3	Property Posting	LS	4000	1	4
4	Subtotal Construction Cost				17
5	Mobilization (10%)				2
6	Engineering (15%)				3
7	Contingencies (25%)				4
8	Total Project Cost				26

Table B.16

Estimated Capital Cost for Implementation of Alternative 3-2

Item Number	Item Description	Unit Of Measure	Unit Cost	Quantity	Cost (000$)
1	Property Record Review and Annotation	LS	11000	1	11
2	Develop Notification Plan	LS	19000	1	19
3	Property Posting	LS	7000	1	7
4	Detailed Sampling and Analysis Plan	LS	21000	1	21
5	Action Level and Response Plan	LS	76000	1	76
6	Subtotal Construction Cost				134
7	Mobilization (10%)				13
8	Engineering (15%)				20
9	Contingencies (25%)				34
10	Total Project Cost				201

Table B.17

Estimated Capital Cost for Implementation of Alternative 3-3A

Item Number	Item Description	Unit Of Measure	Unit Cost	Quantity	Cost (000$)
1	Support Facilities	LS	65000	1	65
2	Site Preparation	LS	24000	1	24
3	Excavation Class I (Dry)	CY	5	1388	7
4	Excavation Class I (Wet)	CY	10	1711	18
5	Excavation Class III	CY	4	4421	18
6	Materials Classification Facility	LS	43000	1	43
7	Backfilling	CY	23	9022	208
8	Transportation Class I	CY	50	4337	217
9	Transportation Class III	CY	15	6189	93
10	Disposal Class I (Non RCRA)	CY	157	4337	681
11	Disposal Class III	CY	20	6189	124
12	Final Grading	SY	1	28962	29
13	Revegetation	SY	1	28962	29
14	Subtotal Construction Cost				1556
15	Mobilization (10%)				156
16	Engineering (15%)				234
17	Contingencies (25%)				389
18	Total Project Cost				2335

Table B.18

Estimated Capital Cost for Implementation of Alternative 3-3C

Item Number	Item Description	Unit Of Measure	Unit Cost	Quantity	Cost (000$)
1	Support Facilities	LS	65000	1	65
2	Site Preparation	LS	24000	1	24
3	Excavation Class I (Dry)	CY	5	1388	7
4	Excavation Class I (Wet)	CY	10	1711	18
5	Excavation Class III	CY	4	4421	18
6	Materials Classification Facility	LS	43000	1	43
7	Backfilling	CY	23	9022	203
8	Immobilization Laboratory/ Pilot Study	LS	100000	1	100
9	Chemical Immobilization Facility	LS	40000	1	40
10	Stabilization of Materials	CY	46	4337	200
11	Transportation Class III	CY	15	11828	178
12	Disposal Class III	CY	20	11828	237
13	Final Grading	SY	1	28962	29
14	Revegetation	SY	1	28962	29
15	Subtotal Construction Cost				1186
16	Mobilization (10%)				119
17	Engineering (15%)				178
18	Contingencies (25%)				297
19	Total Project Cost				1780

Table B.19

Estimated Capital Cost for Implementation of Alternative 3-3D

Item Number	Item Description	Unit Of Measure	Unit Cost	Quantity	Cost (000$)
1	Support Facilities	LS	65000	1	65
2	Site Preparation	LS	24000	1	24
3	Excavation Class I (Dry)	CY	5	1388	7
4	Excavation Class I (Wet)	CY	10	1711	18
5	Excavation Class III	CY	4	4421	18
6	Materials Classification Facility	LS	43000	1	43
7	Backfilling	CY	23	9022	208
8	Immobilization Laboratory/ Pilot Study	LS	100000	1	100
9	Chemical Immobilization Facility	LS	40000	1	40
10	Stabilization of Materials	CY	46	4337	200
11	Transportation Class III	CY	10	11828	119
12	Monofill Disposal Class I	CY	30	11828	355
13	Final Grading	SY	1	28962	29
14	Revegetation	SY	1	28962	29
15	Subtotal Construction Cost				1255
16	Mobilization (10%)				126
17	Engineering (15%)				189
18	Contingencies (25%)				314
19	Total Project Cost				1884

Table B.20

Estimated Capital Cost for Implementation of Alternative 3-3E

Item Number	Item Description	Unit Of Measure	Unit Cost	Quantity	Cost (000$)
1	Support Facilities	LS	65000	1	65
2	Site Preparation	LS	24000	1	24
3	Excavation Class I (Dry)	CY	5	1388	7
4	Excavation Class I (Wet)	CY	10	1711	18
5	Excavation Class III	CY	4	4421	18
6	Materials Classification Facility	LS	43000	1	43
7	Backfilling	CY	23	9022	208
8	Soil Washing Laboratory/ Pilot Study	LS	200000	1	200
9	Soil Washing Facility	LS	40000	1	40
10	Soil Washing	CY	200	3098	620
11	Transportation Class I	CY	50	620	31
12	Transportation Class III	CY	15	10527	158
13	Disposal Class I	CY	239	620	149
14	Disposal Class III	CY	20	10527	211
15	Final Grading	SY	1	28962	29
16	Revegetation	SY	1	28962	29
17	Subtotal Construction Cost				1840
18	Mobilization (10%)				184
19	Engineering (15%)				276
20	Contingencies (25%)				460
21	Total Project Cost				2760

Table B.21

Estimated Capital Cost for Implementation of Alternative 3-3F

Item Number	Item Description	Unit Of Measure	Unit Cost	Quantity	Cost (000$)
1	Support Facilities	LS	65000	1	65
2	Site Preparation	LS	24000	1	24
3	Excavation Class I (Dry)	CY	5	1388	7
4	Excavation Class I (Wet)	CY	10	1711	18
5	Excavation Class III	CY	4	4421	18
6	Materials Classification Facility	LS	43000	1	43
7	Backfilling	CY	23	9022	208
8	Soil Washing Laboratory/ Pilot Study	LS	200000	1	200
9	Soil Washing Facility	LS	40000	1	40
10	Soil Washing	CY	200	3098	620
11	Transportation Class I	CY	50	620	31
12	Transportation Class III	CY	10	10527	106
13	Disposal Class I	CY	239	620	149
14	Monofill Disposal Class III	CY	18	10527	190
15	Final Grading	SY	1	28962	29
16	Revegetation	SY	1	28962	29
17	Subtotal Construction Cost				1777
18	Mobilization (10%)				178
19	Engineering (15%)				267
20	Contingencies (25%)				445
21	Total Project Cost				2667

Table B.22

Estimated Capital Cost for Implementation of Alternative 4-1

Item Number	Item Description	Unit Of Measure	Unit Cost	Quantity	Cost (000$)
1	Develop Notification Plan	LS	2000	1	2
2	Property Record Review and Annotation	LS	1000	1	1
3	Property Posting	LS	2000	1	2
4	Subtotal Construction Cost				5
5	Mobilization (10%)				1
6	Engineering (15%)				1
7	Contingencies (25%)				1
8	Total Project Cost				8

Table B.23

Estimated Capital Cost for Implementation of Alternative 4-2

Item Number	Item Description	Unit Of Measure	Unit Cost	Quantity	Cost (000$)
1	Property Record Review and Annotation	LS	1000	1	1
2	Develop Notification Plan	LS	2000	1	2
3	Property Posting	LS	2000	1	2
4	Detailed Sampling and Analysis Plan	LS	2000	1	2
5	Action Level and Response Plan	LS	8000	1	8
6	Subtotal Construction Cost				15
7	Mobilization (10%)				2
8	Engineering (15%)				2
9	Contingencies (25%)				4
10	Total Project Cost				23

Table B.24

Estimated Capital Cost for Implementation of Alternative 4-3A

Item Number	Item Description	Unit Of Measure	Unit Cost	Quantity	Cost (000$)
1	Support Facilities	LS	65000	1	65
2	Site Preparation	LS	6000	1	6
3	Excavation Class I	CY	5	903	5
4	Materials Classification Facility	LS	43000	1	43
5	Backfilling	CY	23	1684	39
6	Transportation Class I	CY	50	1265	64
7	Disposal Class I	CY	157	1265	199
8	Final Grading	SY	1	7206	8
9	Revegetation	SY	1	7206	8
10	Liming	SY	4	1500	6
11	Subtotal Construction Cost				443
12	Mobilization (10%)				45
13	Engineering (15%)				67
14	Contingencies (25%)				111
15	Total Project Cost				666

Table B.25

Estimated Capital Cost for Implementation of Alternative 4-3C

Item Number	Item Description	Unit Of Measure	Unit Cost	Quantity	Cost (000$)
1	Support Facilities	LS	65000	1	65
2	Site Preparation	LS	6000	1	6
3	Excavation Class I	CY	5	903	5
4	Materials Classification Facility	LS	43000	1	43
5	Backfilling	CY	23	1684	39
6	Immobilization Laboratory/ Pilot Study	LS	100000	1	100
7	Chemical Immobilization Facility	LS	40000	1	40
8	Stabilization of Materials	CY	46	1265	59
9	Transportation Class III	CY	15	1645	25
10	Disposal Class III	CY	20	1645	33
11	Final Grading	SY	1	7206	8
12	Revegetation	SY	1	7206	8
13	Liming	SY	4	1500	6
14	Subtotal Construction Cost				437
15	Mobilization (10%)				44
16	Engineering (15%)				66
17	Contingencies (25%)				110
18	Total Project Cost				657

Table B.26

Estimated Capital Cost for Implementation of Alternative 4-3D

Item Number	Item Description	Unit Of Measure	Unit Cost	Quantity	Cost (000$)
1	Support Facilities	LS	65000	1	65
2	Site Preparation	LS	6000	1	6
3	Excavation Class I	CY	5	903	5
4	Materials Classification Facility	LS	43000	1	43
5	Backfilling	CY	23	1684	39
6	Immobilization Laboratory/ Pilot Study	LS	100000	1	100
7	Chemical Immobilization Facility	LS	40000	1	40
8	Stabilization of Materials	CY	46	1265	59
9	Transportation Class III	CY	10	1645	17
10	Monofill Disposal Class I	CY	30	1645	50
11	Final Grading	SY	1	7206	8
12	Revegetation	SY	1	7206	8
13	Liming	SY	4	1500	6
14	Subtotal Construction Cost				446
15	Mobilization (10%)				45
16	Engineering (15%)				67
17	Contingencies (25%)				112
18	Total Project Cost				670

Table B.27

Estimated Capital Cost for Implementation of Alternative 4-3E

Item Number	Item Description	Unit Of Measure	Unit Cost	Quantity	Cost (000$)
1	Support Facilities	LS	65000	1	65
2	Site Preparation	LS	6000	1	6
3	Excavation Class I	CY	5	903	5
4	Materials Classification Facility	LS	43000	1	43
5	Backfilling	CY	23	1684	39
6	Soil Washing Laboratory/ Pilot Study	LS	200000	1	200
7	Soil Washing Facility Facility	LS	40000	1	40
8	Soil Washing	CY	200	903	181
9	Transportation Class I	CY	50	181	10
10	Transportation Class III	CY	15	1265	19
11	Disposal Class I (RCRA)	CY	239	181	44
12	Disposal Class III	CY	20	1265	26
13	Final Grading	SY	1	7206	8
14	Revegetation	SY	1	7206	8
15	Liming	SY	4	1500	6
16	Subtotal Construction Cost				700
17	Mobilization (10%)				70
18	Engineering (15%)				105
19	Contingencies (25%)				175
20	Total Project Cost				1050

Table B.28

Estimated Capital Cost for Implementation of Alternative 4-3F

Item Number	Item Description	Unit Of Measure	Unit Cost	Quantity	Cost (000$)
1	Support Facilities	LS	65000	1	65
2	Site Preparation	LS	6000	1	6
3	Excavation Class I	CY	5	903	5
4	Materials Classification Facility	LS	43000	1	43
5	Backfilling	CY	23	1684	39
6	Soil Washing Laboratory/ Pilot Study	LS	200000	1	200
7	Soil Washing Facility Facility	LS	40000	1	40
8	Soil Washing	CY	200	903	181
9	Transportation Class I	CY	50	181	10
10	Transportation Class III	CY	10	1265	13
11	Disposal Class I (RCRA)	CY	239	181	44
12	Monofill Disposal Class III	CY	18	1265	23
13	Final Grading	SY	1	7206	8
14	Revegetation	SY	1	7206	8
15	Liming	SY	4	1500	6
16	Subtotal Construction Cost				691
17	Mobilization (10%)				70
18	Engineering (15%)				104
19	Contingencies (25%)				173
20	Total Project Cost				1038

Table B.29

Estimated Capital Cost for Implementation of Alternative 4-4A

Item Number	Item Description	Unit Of Measure	Unit Cost	Quantity	Cost (000$)
1	Support Facilities	LS	65000	1	65
2	Site Preparation	LS	6000	1	6
3	Initial Site Grading	SY	1	7206	8
4	Clean Fill Cover	CY	28	6388	179
5	Top Soil Cover	CY	28	6388	179
6	Final Grading	SY	1	7206	8
7	Revegetation	SY	1	7206	8
8	Liming	SY	4	1500	6
9	Subtotal Construction Cost				459
10	Mobilization (10%)				46
11	Engineering (15%)				69
12	Contingencies (25%)				115
13	Total Project Cost				689

Table B.30

Estimated Capital Cost for Implementation of Alternative 4-4B

Item Number	Item Description	Unit Of Measure	Unit Cost	Quantity	Cost (000$)
1	Support Facilities	LS	65000	1	65
2	Site Preparation	LS	6000	1	6
3	Initial Site Grading	SY	1	7206	8
4	Clean Fill Cover	CY	28	6388	179
5	RCRA Cover	SY	39	7206	282
6	Final Grading	SY	1	7206	8
7	Revegetation	SY	1	7206	8
8	Liming	SY	4	1500	6
9	Subtotal Construction Cost				562
10	Mobilization (10%)				57
11	Engineering (15%)				85
12	Contingencies (25%)				141
13	Total Project Cost				845

APPENDIX C: ESTIMATED O&M COSTS FOR ALTERNATIVE REMEDIAL ACTIONS

AD-A199 116 FEASIBILITY STUDY OF CONTAMINATION REMEDIATION AT NAVAL 10/10
WEAPONS STATION C..(U) ARMY ENGINEER WATERWAYS
EXPERIMENT STATION VICKSBURG MS ENVIR..
UNCLASSIFIED M J CULLINANE ET AL. SEP 88 F/G 24/3 NL

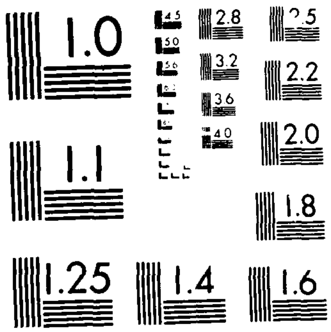
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Table C.1

Estimated O&M Cost for Implementation of Alternative 1-1[1]

Item Number	Item Description	O&M Estimated Cost (000$/yr) Year 1-5	Year 6-30
1	Maintenance of Notification Plan	2	2
2	Annual Site Inspection Report	5	5
3	Sign Maintenance	2	2
4	Subtotal	9	9
5	Administration	3	3
6	Contingency (25%)	3	3
7	Total	15	15

1. Cost for operation and maintenance rounded to next higher $1,000.

Table C.2

Estimated O&M Cost for Implementation of Alternative 1-2[1]

Item Number	Item Description	O&M Estimated Cost (000$/yr) Year 1-5	Year 6-30
1	Maintenance of Notification Plan	2	2
2	Sign Maintenance	2	2
3	Phase 1 Sampling and Analysis	153	31
4	Phase 2 Sampling and Analysis[2]	54	18
5	Annual Site Inspection Report	10	2
6	Subtotal	221	55
7	Administration (10%)	23	6
8	Contingency (25%)	56	14
9	Total	300	75

1. Cost for operation and maintenance rounded to next higher $1,000.

2. These activities conducted every two years for the first five years and every five years thereafter.

Table C.3

Estimated O&M Cost for Implementation of Alternative 1-3A[1]

Item Number	Item Description	O&M Estimated Cost (000$/yr) Year 1-5	Year 6-30
1	Maintenance of Notification Plan	2	2
2	Remedial Site Maintenance	11	6
3	Phase 1 Sampling and Analysis	117	24
4	Phase 2 Sampling and Analysis[2]	45	15
5	Annual Site Report	10	2
6	Subtotal	185	49
7	Administration (10%)	19	5
8	Contingency (25%)	47	13
9	Total	251	67

1. Cost for operation and maintenance rounded to next higher $1,000.

2. These activities conducted every two years for the first five years and every five years thereafter.

Table C.4

Estimated O&M Cost for Implementation of Alternative 1-3C[1]

Item Number	Item Description	O&M Estimated Cost (000$/yr) Year 1-5	Year 6-30
1	Maintenance of Notification Plan	2	2
2	Remedial Site Maintenance	11	6
3	Phase 1 Sampling and Analysis	117	24
4	Phase 2 Sampling and Analysis[2]	45	15
5	Annual Site Report	10	2
6	Subtotal	185	49
7	Administration (10%)	19	5
8	Contingency (25%)	47	13
9	Total	251	67

1. Cost for operation and maintenance rounded to next higher $1,000.

2. These activities conducted every two years for the first five years and every five years thereafter.

Table C.5

Estimated O&M Cost for Implementation of Alternative 1-3D[1]

Item Number	Item Description	O&M Estimated Cost (000$/yr) Year 1-5	Year 6-30
1	Maintenance of Notification Plan	2	2
2	Remedial Site Maintenance	11	6
3	Phase 1 Sampling and Analysis	117	24
4	Phase 2 Sampling and Analysis[2]	45	15
5	Annual Site Inspection Report	10	2
6	Monofill Maintenance	130	120
7	Subtotal	315	169
8	Administration (10%)	32	17
9	Contingency (25%)	79	43
10	Total	426	229

1. Cost for operation and maintenance rounded to next higher $1,000.

2. These activities conducted every two years for the first five years and every five years thereafter.

Table C.6

Estimated O&M Cost for Implementation of Alternative 1-3E[1]

Item Number	Item Description	O&M Estimated Cost (000$/yr) Year 1-5	Year 6-30
1	Maintenance of Notification Plan	2	2
2	Remedial Site Maintenance	11	6
3	Phase 1 Sampling and Analysis	117	24
4	Phase 2 Sampling and Analysis[2]	45	15
5	Annual Site Inspection Report	10	2
6	Subtotal	185	49
7	Administration	19	5
8	Contingency (25%)	47	13
9	Total	251	67

1. Cost for operation and maintenance rounded to next higher $1,000.

2. These activities conducted every two years for the first five years and every five years thereafter.

Table C.7

Estimated O&M Cost for Implementation of Alternative 1-3F[1]

Item Number	Item Description	O&M Estimated Cost (000$/yr) Year 1-5	Year 6-30
1	Maintenance of Notification Plan	2	2
2	Remedial Site Maintenance	11	6
3	Phase 1 Sampling and Analysis	117	24
4	Phase 2 Sampling and Analysis[2]	45	15
5	Annual Site Inspection Report	10	2
6	Disposal Site Maintenance	35	30
7	Subtotal	220	79
8	Administration (10%)	22	8
9	Contingency (25%)	55	20
10	Total	297	107

1. Cost for operation and maintenance rounded to next higher $1,000.

2. These activities conducted every two years for the first five years and every five years thereafter.

Table C.8

Estimated O&M Cost for Implementation of Alternative 2-1[1]

Item Number	Item Description	O&M Estimated Cost (000$/yr) Year 1-5	Year 6-30
1	Maintenance of Notification Plan	2	2
2	Annual Site Inspection Report	5	5
3	Sign Maintenance	2	2
4	Subtotal	9	9
5	Administration (10%)	3	3
6	Contingency (25%)	3	3
7	Total	15	15

1. Cost for operation and maintenance rounded to next higher $1,000.

Table C.9

Estimated O&M Cost for Implementation of Alternative 2-2[1]

Item Number	Item Description	O&M Estimated Cost (000$/yr) Year 1-5	Year 6-30
1	Maintenance of Notification Plan	2	2
2	Sign Maintenance	2	2
3	Phase 1 Sampling and Analysis	33	7
4	Phase 2 Sampling and Analysis[2]	18	6
5	Annual Site Inspection Report	10	2
6	Subtotal	65	19
7	Administration (10%)	7	3
8	Contingency (25%)	17	5
9	Total	89	27

1. Cost for operation and maintenance rounded to next higher $1,000.
2. These activities conducted every two years for the first five years and every five years thereafter.

Table C.10

Estimated O&M Cost for Implementation of Alternative 2-3A[1]

Item Number	Item Description	O&M Estimated Cost (000$/yr) Year 1-5	Year 6-30
1	Maintenance of Notification Plan	2	2
2	Remedial Site Maintenance	7	4
3	Phase 1 Sampling and Analysis	13	3
4	Phase 2 Sampling and Analysis[2]	14	5
5	Annual Site Report	10	2
6	Subtotal	46	16
7	Administration (10%)	5	2
8	Contingency (25%)	12	4
9	Total	63	22

1. Cost for operation and maintenance rounded to next higher $1,000.

2. These activities conducted every two years for the first five years and every five years thereafter.

Table C.11

Estimated O&M Cost for Implementation of Alternative 2-3C[1]

Item Number	Item Description	O&M Estimated Cost (000$/yr) Year 1-5	Year 6-30
1	Maintenance of Notification Plan	2	2
2	Remedial Site Maintenance	7	4
3	Phase 1 Sampling and Analysis	13	7
4	Phase 2 Sampling and Analysis[2]	14	5
5	Annual Site Report	10	2
6	Subtotal	46	16
7	Administration (10%)	5	2
8	Contingency (25%)	12	4
9	Total	63	22

1. Cost for operation and maintenance rounded to next higher $1,000.

2. These activities conducted every two years for the first five years and every five years thereafter.

Table C.12

Estimated O&M Cost for Implementation of Alternative 2-3D[1]

Item Number	Item Description	O&M Estimated Cost (000$/yr) Year 1-5	Year 6-30
1	Maintenance of Notification Plan	2	2
2	Remedial Site Maintenance	7	4
3	Phase 1 Sampling and Analysis	13	3
4	Phase 2 Sampling and Analysis[2]	14	5
5	Annual Site Inspection Report	10	2
6	Monofill Maintenance	130	120
7	Subtotal	176	136
8	Administration (10%)	18	14
9	Contingency (25%)	44	34
10	Total	238	184

1. Cost for operation and maintenance rounded to next higher $1,000.

2. These activities conducted every two years for the first five years and every five years thereafter.

Table C.13

Estimated O&M Cost for Implementation of Alternative 2-3E[1]

Item Number	Item Description	O&M Estimated Cost (000$/yr) Year 1-5	Year 6-30
1	Maintenance of Notification Plan	2	2
2	Remedial Site Maintenance	7	4
3	Phase 1 Sampling and Analysis	13	3
4	Phase 2 Sampling and Analysis[2]	14	5
5	Annual Site Inspection Report	10	2
6	Subtotal	46	16
7	Administration (10%)	5	2
8	Contingency (25%)	12	4
9	Total	63	22

1. Cost for operation and maintenance rounded to next higher $1,000.

2. These activities conducted every two years for the first five years and every five years thereafter.

Table C.14

Estimated O&M Cost for Implementation of Alternative 2-3F[1]

Item Number	Item Description	O&M Estimated Cost (000$/yr) Year 1-5	Year 6-30
1	Maintenance of Notification Plan	2	2
2	Remedial Site Maintenance	7	4
3	Phase 1 Sampling and Analysis	13	3
4	Phase 2 Sampling and Analysis[2]	14	5
5	Annual Site Inspection Report	10	2
6	Disposal Site Maintenance	35	30
7	Subtotal	81	46
8	Administration (10%)	8	5
9	Contingency (25%)	21	12
10	Total	110	63

1. Cost for operation and maintenance rounded to next higher $1,000.

2. These activities conducted every two years for the first five years and every five years thereafter.

Table C.15

Estimated O&M Cost for Implementation of Alternative 3-1[1]

Item Number	Item Description	O&M Estimated Cost (000$/yr) Year 1-5	Year 6-30
1	Maintenance of Notification Plan	2	2
2	Annual Site Inspection Report	5	5
3	Sign Maintenance	2	2
4	Subtotal	9	9
5	Administration (10%)	3	3
6	Contingency (25%)	3	3
7	Total	15	15

1. Cost for operation and maintenance rounded to next higher $1,000.

Table C.16

Estimated O&M Cost for Implementation of Alternative 3-2[1]

Item Number	Item Description	O&M Estimated Cost (000$/yr) Year 1-5	Year 6-30
1	Maintenance of Notification Plan	2	2
2	Sign Maintenance	2	2
3	Phase 1 Sampling and Analysis	44	9
4	Phase 2 Sampling and Analysis[2]	7	3
5	Annual Site Inspection Report	10	2
6	Subtotal	65	18
7	Administration (10%)	7	3
8	Contingency (25%)	17	5
9	Total	89	26

1. Cost for operation and maintenance rounded to next higher $1,000.

2. These activities conducted every two years for the first five years and every five years thereafter.

Table C.17

Estimated O&M Cost for Implementation of Alternative 3-3A[1]

Item Number	Item Description	O&M Estimated Cost (000$/yr) Year 1-5	Year 6-30
1	Maintenance of Notification Plan	2	2
2	Remedial Site Maintenance	6	3
3	Phase 1 Sampling and Analysis	20	4
4	Phase 2 Sampling and Analysis[2]	3	1
5	Annual Site Report	10	2
6	Subtotal	41	12
7	Administration (10%)	4	3
8	Contingency (25%)	11	3
9	Total	56	18

1. Cost for operation and maintenance rounded to next higher $1,000.

2. These activities conducted every two years for the first five years and every five years thereafter.

Table C.18

Estimated O&M Cost for Implementation of Alternative 3-3C[1]

Item Number	Item Description	O&M Estimated Cost (000$/yr) Year 1-5	Year 6-30
1	Maintenance of Notification Plan	2	2
2	Remedial Site Maintenance	6	3
3	Phase 1 Sampling and Analysis	20	4
4	Phase 2 Sampling and Analysis[2]	3	1
5	Annual Site Report	10	2
6	Subtotal	41	12
7	Administration (10%)	4	3
8	Contingency (25%)	11	3
9	Total	56	18

1. Cost for operation and maintenance rounded to next higher $1,000.

2. These activities conducted every two years for the first five years and every five years thereafter.

Table C.19

Estimated O&M Cost for Implementation of Alternative 3-3D[1]

Item Number	Item Description	O&M Estimated Cost (000$/yr) Year 1-5	Year 6-30
1	Maintenance of Notification Plan	2	2
2	Remedial Site Maintenance	6	3
3	Phase 1 Sampling and Analysis	20	4
4	Phase 2 Sampling and Analysis[2]	3	1
5	Annual Site Inspection Report	10	2
6	Monofill Maintenance	130	120
7	Subtotal	171	132
8	Administration (10%)	17	13
9	Contingency (25%)	43	33
10	Total	231	178

1. Cost for operation and maintenance rounded to next higher $1,000.

2. These activities conducted every two years for the first five years and every five years thereafter.

Table C.20

Estimated O&M Cost for Implementation of Alternative 3-3E[1]

Item Number	Item Description	O&M Estimated Cost (000$/yr) Year 1-5	Year 6-30
1	Maintenance of Notification Plan	2	2
2	Remedial Site Maintenance	6	3
3	Phase 1 Sampling and Analysis	20	4
4	Phase 2 Sampling and Analysis[2]	3	1
5	Annual Site Inspection Report	10	2
6	Subtotal	41	12
7	Administration (10%)	4	3
8	Contingency (25%)	11	3
9	Total	56	18

1. Cost for operation and maintenance rounded to next higher $1,000.

2. These activities conducted every two years for the first five years and every five years thereafter.

Table C.21

Estimated O&M Cost for Implementation of Alternative 3-3F[1]

Item Number	Item Description	O&M Estimated Cost (000$/yr) Year 1-5	Year 6-30
1	Maintenance of Notification Plan	2	2
2	Remedial Site Maintenance	6	3
3	Phase 1 Sampling and Analysis	20	4
4	Phase 2 Sampling and Analysis[2]	3	1
5	Annual Site Inspection Report	10	2
6	Disposal Site Maintenance	35	30
7	Subtotal	76	42
8	Administration (10%)	8	4
9	Contingency (25%)	19	11
10	Total	103	57

1. Cost for operation and maintenance rounded to next higher $1,000.

2. These activities conducted every two years for the first five years and every five years thereafter.

Table C.22

Estimated O&M Cost for Implementation of Alternative 4-1[1]

Item Number	Item Description	O&M Estimated Cost (000$/yr) Year 1-5	Year 6-30
1	Maintenance of Notification Plan	2	2
2	Annual Site Inspection Report	5	5
3	Sign Maintenance	2	2
4	Subtotal	9	9
5	Administration (10%)	3	3
6	Contingency (25%)	3	3
7	Total	15	15

1. Cost for operation and maintenance rounded to next higher $1,000.

Table C.23

Estimated O&M Cost for Implementation of Alternative 4-2[1]

Item Number	Item Description	O&M Estimated Cost (000$/yr) Year 1-5	Year 6-30
1	Maintenance of Notification Plan	2	2
2	Sign Maintenance	2	2
3	Phase 1 Sampling and Analysis	24	5
4	Phase 2 Sampling and Analysis[2]	7	3
5	Annual Site Inspection Report	10	2
6	Subtotal	45	14
7	Administration (10%)	5	3
8	Contingency (25%)	12	4
9	Total	62	21

1. Cost for operation and maintenance rounded to next higher $1,000.
2. These activities conducted every two years for the first five years and every five years thereafter.

Table C.24

Estimated O&M Cost for Implementation of Alternative 4-3A[1]

Item Number	Item Description	O&M Estimated Cost (000$/yr) Year 1-5	Year 6-30
1	Maintenance of Notification Plan	2	2
2	Remedial Site Maintenance	1	1
3	Phase 1 Sampling and Analysis	20	4
4	Phase 2 Sampling and Analysis[2]	6	2
5	Annual Site Report	10	2
6	Subtotal	39	11
7	Administration (10%)	4	3
8	Contingency (25%)	10	3
9	Total	53	17

1. Cost for operation and maintenance rounded to next higher $1,000.

2. These activities conducted every two years for the first five years and every five years thereafter.

Table C.25

Estimated O&M Cost for Implementation of Alternative 4-3C[1]

Item Number	Item Description	O&M Estimated Cost (000$/yr) Year 1-5	Year 6-30
1	Maintenance of Notification Plan	2	2
2	Remedial Site Maintenance	1	1
3	Phase 1 Sampling and Analysis	20	4
4	Phase 2 Sampling and Analysis[2]	6	2
5	Annual Site Report	10	2
6	Subtotal	39	11
7	Administration (10%)	4	3
8	Contingency (25%)	10	3
9	Total	53	17

1. Cost for operation and maintenance rounded to next higher $1,000.

2. These activities conducted every two years for the first five years and every five years thereafter.

Table C.26

Estimated O&M Cost for Implementation of Alternative 4-3D[1]

Item Number	Item Description	O&M Estimated Cost (000$/yr) Year 1-5	Year 6-30
1	Maintenance of Notification Plan	2	2
2	Remedial Site Maintenance	1	1
3	Phase 1 Sampling and Analysis	20	4
4	Phase 2 Sampling and Analysis[2]	6	2
5	Annual Site Inspection Report	10	2
6	Monofill Maintenance	130	120
7	Subtotal	169	131
8	Administration (10%)	17	13
9	Contingency (25%)	43	33
10	Total	229	177

1. Cost for operation and maintenance rounded to next higher $1,000.

2 These activities conducted every two years for the first five years and every five years thereafter.

Table C.27

Estimated O&M Cost for Implementation of Alternative 4-3E[1]

Item Number	Item Description	O&M Estimated Cost (000$/yr) Year 1-5	Year 6-30
1	Maintenance of Notification Plan	2	2
2	Remedial Site Maintenance	1	1
3	Phase 1 Sampling and Analysis	20	4
4	Phase 2 Sampling and Analysis[2]	6	2
5	Annual Site Inspection Report	10	2
6	Subtotal	39	11
7	Administration (10%)	4	3
8	Contingency (25%)	10	3
9	Total	53	17

1. Cost for operation and maintenance rounded to next higher $1,000.

2. These activities conducted every two years for the first five years and every five years thereafter.

Table C.28

Estimated O&M Cost for Implementation of Alternative 4-3F[1]

Item Number	Item Description	O&M Estimated Cost (000$/yr) Year 1-5	Year 6-30
1	Maintenance of Notification Plan	2	2
2	Remedial Site Maintenance	1	1
3	Phase 1 Sampling and Analysis	20	4
4	Phase 2 Sampling and Analysis[2]	6	2
5	Annual Site Inspection Report	10	2
6	Disposal Site Maintenance	35	30
7	Subtotal	74	41
8	Administration (10%)	8	4
9	Contingency (25%)	19	11
10	Total	101	56

1. Cost for operation and maintenance rounded to next higher $1,000.

2. These activities conducted every two years for the first five years and every five years thereafter.

Table C.29

Estimated O&M Cost for Implementation of Alternative 4-4A[1]

Item Number	Item Description	O&M Estimated Cost (000$/yr) Year 1-5	Year 6-30
1	Maintenance of Notification Plan	2	2
2	Remedial Site Maintenance	1	1
3	CAP Maintenance	3	2
4	Phase 1 Sampling and Analysis	20	4
5	Phase 2 Sampling and Analysis[2]	6	2
6	Annual Site Inspection Report	10	2
7	Subtotal	42	13
8	Administration (10%)	5	2
9	Contingency (25%)	12	4
10	Total	59	19

1. Cost for operation and maintenance rounded to next higher $1,000.

2. These activities conducted every two years for the first five years and every five years thereafter.

Table C.30

Estimated O&M Cost for Implementation of Alternative 4-4B[1]

Item Number	Item Description	O&M Estimated Cost (000$/yr) Year 1-5	Year 6-30
1	Maintenance of Notification Plan	2	2
2	Remedial Site Maintenance	1	1
3	CAP Maintenance	4	3
4	Phase 1 Sampling and Analysis	20	4
5	Phase 2 Sampling and Analysis[2]	6	2
6	Annual Site Inspection Report	10	2
7	Subtotal	43	14
8	Administration (10%)	4	2
9	Contingency (25%)	14	4
10	Total	61	20

1. Cost for operation and maintenance rounded to next higher $1,000.

2. These activities conducted every two years for the first five years and every five years thereafter.

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